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THE COLEMAN HYDROELECTRIC PLANT.

This interesting installation, which is described elsewhere in our columns, is a highly characteristic piece of California engineering. Long years of experience in irrigating and power work have given the engineers on the Pacific coast a fearlessness and skill in handling hydraulic propositions that produce very admirable results. They are not afraid to go ahead and do things, even if somewhat out of the ordinary, and have rarely scored a failure even when their methods have been apparently most heterodox. Hundreds of miles of ditches and pipe lines and scores of sensational head works bear witness to the enterprise which shows so plainly in the plant under consideration. The Coleman plant is one of five, and is in fact the lowest of four upon a single stream, Battle Creek. The situation is one familiar in California practice. The water for the whole 12,000-kw plant is diverted by a dam, 15 ft. high and only 110 ft. long, into a simple and cleanly cut ditch limited on one side by a rubble-basin retaining wall near the dam and then continued through the hard soil. Power from one of the upper plants was utilized along the line of the canal for motor hoists and for compressors, working hoists and other machinery. This line was merely brought down to the lower plant and is so constructed that it will become eventually a part of the main transmission line at 66,000 volts. The canal itself is 10.5 miles long from the head works to the forebay, including one tunnel and two long inverted syphons, one of riveted steel pipe and the other mainly of reinforced concrete. As in most California plants, the whole drop is concentrated in a comparatively short distance where the contour is such that the water can plunge down quickly for the whole available head. The pipe lines proper in this plant are 3600 ft. long for a head of 487 ft. At the power house it was desirable to install three units, and, instead of using three pipe lines, just before reaching the power house a branch of appropriate size is taken from each main pipe, and these two branches are united by a cast-steel Y to the penstock for the third wheel. From each branch, too, is taken a 12-in. pipe for the exciters. Each pipe line, therefore, feeds a generator and a half and one exciter, which gives, considering the connections of the plant, a good hydraulic reserve without the added expense of another 3600-ft. pipe line.

Aside from the automatic regulation of the wheels the system is entirely hand-operated, a scheme which seems to work out very successfully, at least with generators of this size and number, and is simpler and cheaper to install than the more intricate ones commonly used. The wheels themselves are turbines fitted with relief valves, while the exciters are driven by impulse wheels with needle regulating nozzles. The whole capacity, 4000 kva, of each generator is taken up by a single three-phase oil trans-

former, raising the voltage from 6600 to 66,000, while a spare unit is at hand in case of need. A very ingenious feature of the power house is the method of managing the transformer oil. In the space under the switchboard are two oil tanks, 6 ft. in diameter and 16 ft. long, which can be filled from the power-house floor through manholes. These tanks are connected by pipes to the transformers so that by putting air pressure in the tank from a motor-driven compressor oil may be forced into any of the transformers or from one tank through an oil filter into another. The circulation of oil for all purposes is accomplished in this convenient manner. The structure of the power house is simple and cheap, the frame being of steel and the walls of 2-in. cement plaster on expanded metal, forming dense concrete slabs. The roof is corrugated galvanized iron and the gutters, like the walls, are of reinforced concrete. Altogether the whole design of the plant is exceptionally simple and workmanlike, an example of combined efficiency and cheapness. It would be very interesting to compare the cost of this plant per kilowatt of capacity with that of some of the more pretentious power houses with which we are familiar in the East, and to figure, as well, the fixed charges due to the whole hydraulic system. The installation certainly strikes one as well worthy of study by anyone who is contemplating building a plant at high head with close regard for economy of construction.

WATT-HOUR METERS IN LABORATORY TESTS.

Among the reports presented to the Turin Electrotechnical Congress was one by M. Albert Durand on tests of consumers' watt-hour meters as made at the Central Electrical Laboratory in Paris and referred to recently in the *Digest*. It is pointed out in the report that the temperature error is one of the most serious that the ordinary recording watt-hour meter is subject to, because when its cover is closed tightly, so as to exclude dust, the losses of power occurring at or near rated load produce a very appreciable temperature elevation of the working parts. This means that the eddy currents set up in the rotating copper or aluminum brake disk tend to be reduced as the temperature rises, thus accelerating the meter-motor speeds under load, unless some automatic compensation is introduced. Another noteworthy source of error pointed out in the report is the effect of short-circuit currents on the subsequent registration of the instrument, owing to demagnetizing effects of the excessive currents.

The report concludes that, in view of the low existing rates of electric supply, a relatively small percentage of error in the registration of the watt-hour meters in service on a system may exert a relatively large depreciatory influence upon the income from the system, and that this justifies a larger and more expensive form of customer's watt-hour meter than has been ordinarily employed in France during the past. The report also deprecates the certification of meters by testing laboratories to such a degree of precision as 0.1 per cent or even less, as has been the custom, intimating that temperature errors alone do not permit the registration of a meter to be predicted so closely as such certification might imply. The report contains some useful statistics concerning the tolerances and behaviors of European meters under different conditions of service in different countries. Thus, at rated load, the percentage of error allowed as a balance limit in meters is 3 per cent in England and France, 3.3 per cent in Germany and 4 per cent in Spain and Austria. The rules on meter behavior are specified and set in force by government action in Europe, in connection with taxation systems of particular countries, so that particular interest attaches to the meter tests of the national government laboratories.

QUANTITATIVE EXPERIMENTS IN LONG-DISTANCE RADIOTELEGRAPHY.

The laws which control the range of practicable wireless telegraphy are of great importance, both theoretically and practically. Every addition to the available working range between ships at sea and a central shore station constitutes an increase in the powers of social organization for peace, as well as in those of military organization for war. The range depends upon a number of factors, some of which relate to the power of the sending station, others to the sensitiveness of the receiving station, and yet others to geological and meteorological conditions. It was found by Duddell, in 1905, that at short distances—that is, up to a range of, say, 200 km—the current strength received in a tuned receiving antenna path to ground, from a given synchronously tuned sending ship station, varied inversely as the ship's distance from the station; and since the power expended in any thermal receiver is as the square of the current, when the sending station is kept in sustained action, the received power varies inversely as the square of the distance. This law of short-range action is consistent with the simple hypothesis that the waves emitted from the sending station expand equally in all directions and do not undergo any attenuation except that which is due to such expansion. But it is known that loss of radiation energy takes place in the waves transmitted to long distances, both in the ocean below and in the sky above. The loss at the surface of the ocean must occur owing to imperfect electric conductivity of salt water, whereby the waves sink somewhat into the sea, instead of merely skimming over the surface. The loss in the sky is evidenced by the fact that in daytime the signals that come from a great distance are ordinarily feebler than in the night-time, and recent observations tend to show that the effects vary greatly with the direction in which transmission is taking place, the results obtained when transmitting in a northerly or southerly direction differing from those obtained when transmitting east or west.

The October number of the *Bulletin* of the Bureau of Standards, just issued, contains an interesting account of some long-range experiments on wireless signals recently carried out by the United States Navy Department between the Fessenden shore station of Brant Rock, Mass., and the cruisers *Birmingham* and *Salem*, at various distances up to 1000 nautical miles or more. The results seem to show that the Duddell law applies at these long ranges, after being modified by the application of an exponential term e^{-Ad}, in which d is the distance and A a constant. This means that the received current falls off faster than the inverse distance, owing to the influence of the ex-

ponential term. These results apply to normal daylight working, and the exponential term assumes the duty of including the effects of absorption both on the sea surface and in the sky. At night-time the signals were stronger, but erratic. Sometimes the night signals were hardly any stronger than the day signals. At other times they were as much stronger as though the exponential term did not apply; that is, as though no absorption occurred, and as though the Duddell law applied over the long range. In a few cases the night signals were reported so much stronger that they would not only call for no exponential-term absorption, but, on the contrary, would need a reinforcing action to explain them.

While as yet we know but little of the electrical behavior of the upper atmosphere, yet all of these conditions can be explained without difficulty. The sun's rays, especially the ultraviolet rays that do not reach down to the earth's surface, ionize the atmosphere to a certain extent when they strike it, and render it partially conducting. It is reasonable to suppose that these masses of ionized air assume the form of invisible clouds in the upper atmosphere. They persist as long as ionization lasts, and somewhat longer, the ionization slowly disappearing in the night hours. The effect of these hypothetical semi-conducting air clouds on transmitted waves will depend on their disposition. If they lie in smooth stratified layers with a sharp surface of discontinuity, they may be able to act like an inverted ocean and conduct the waves like the sea, in which case the signals would be reinforced, since expansion would occur in ring fashion, or only in one dimension—as was pointed out ten years ago in our columns—instead of in two dimensions, like a soap-bubble. If, however, the ionized air clouds lie in irregular masses disturbed by winds, there will be no mirage reflection from their lower surface, but, on the contrary, a great absorption of energy over and above the two-dimensional expansion called for by Duddell's law. It would not be surprising, therefore, if at some future time meteorological observatories, by measuring the strength of long-distance received signals, might be able to arrive at conclusions concerning the quiescence or disturbances of the upper atmosphere, and so to gather advance information concerning weather changes; for it is said that weather changes commence at the top, rather than at the bottom, of the atmospheric ocean beneath which we live.

THE DETERMINATION OF LUMINOUS EFFICIENCY.

Within the last few years several studies have been made of the luminous efficiency of various sources based on the separation of the visible spectrum from the great mass of invisible radiant energy in the infra-red by means of various screens. It would be exceedingly convenient if one could find a screen which would cut off all the infra-red, letting through the whole of the visible spectrum and the ultra-violet, and another screen which should cut off all the ultra-violet, letting through the visible and the infra-red. Thus one could separate the radiations with convenience and precision, working with amounts of energy large enough to give accurate results. A paper by Dr. W. W. Coblentz in the last number of the *Bulletin* of the Bureau of Standards gives in some detail the results of a search for the more important of these possible absorbing screens—that is, the one separating the visible from the infra-red radiations. A search had already been made for a material which would let through the infra-red and absorb all the visible spectrum, and one was found in a very thin screen of asphaltum, which is fairly efficient but too difficult of reproduction to be a pleasing material with which to work.

The present examination unfortunately shows that the later search did not reveal anything of a highly satisfactory character. The best all-around absorbent for infra-red radiation alone is pure water. This is beautifully transparent, both to the visible and ultra-violet rays, but unfortunately its absorption in the infra-red stops at a distance below the last visible red equal to practically the whole length of the visible spectrum. The problem of a suitable screen for determining efficiencies demands the closing up of this gap. The alums have been credited with valuable absorbing power in this region, but apparently, from Dr. Coblentz's results, without any just cause, ordinary alum solution not being any more efficient than water; and even the iron-ammonium alum, which has been used for such purposes, is ineffective in that it both absorbs part of the visible spectrum and lets through part of the invisible which it is desired to keep out. Solutions of a number of copper salts were also tried as screens. These are effective in cutting off most of the infra-red, but are strongly colored so that they also affect the transmission in the visible spectrum very considerably. Cupric chloride seems to have been the most efficient substance tried, and this absorbs the infra-red and extreme red pretty effectively, while letting through a considerable amount of light in the middle of the spectrum. It shows, however, considerable selective absorption here and cuts off most of the ultra-violet, so that, save for special purposes, even it seems to be ineffective. The transmission of a 2 per cent solution of this substance is practically nil for the infra-red in a thickness of a little less than 1 in., but about one-third of the light in the yellow is cut off.

It still remains necessary, therefore, in the determination of efficiencies to make a point-to-point examination by means of a spectro-photometer, even if screening of the infra-red by the means just indicated is adopted, and the ultra-violet region, of much importance in some investigations, still remains as a troublesome factor in the case. One possibility, however, remains to be investigated—that of a separation by selective reflection. Broadly, of course, reflection is well known to be the converse of transmission, as Dr. Coblentz himself determined for many substances in a series of beautiful researches published several years ago. But there are various opaque substances, among them a number of metallic alloys, which are strongly colored and ought to be investigated. If one can be found which would reflect the infra-red very freely and from which the residual luminous rays could be cut off by a suitable absorbing screen, a material gain may be possible. At all events, the subject is one worth looking into with a view to obtaining a more facile method than is now available for the investigation of the luminous efficiency of radiation.

SALE OF LORIMER-LUNDQUIST AUTOMATIC-TELEPHONE PATENTS TO WESTERN ELECTRIC COMPANY.

Last week a note appeared in these columns concerning the sale of automatic-telephone patents, and further particulars on the same subject are given below. From a bill in equity filed in the Superior Court of Cook County, Ill., it appears that in May, 1911, the Lorimer-Lundquist Company, of Chicago, entered into an agreement with the Western Electric Company to sell all its automatic-telephone patents to the latter company. These patents constituted the assets of the Lorimer-Lundquist Company, and the price agreed to be paid was $650,000. On or about Dec. 2, 1911, the Lorimer-Lundquist Company, according to the bill, received $425,000 of this amount in cash, the remainder, $225,000, being placed in escrow. A dispute has arisen among those interested, or claiming to have an interest, in the Lorimer-Lundquist Company, relating to the proceeds of the sale, and a petition in chancery was filed on Dec. 11, 1911, asking for an equitable determination of the various interests involved and restraining the paying out of any further moneys until the rights of all the parties to the suit have been adjudicated. The filing of this complaint made of record the interesting fact that the Western Electric Company had purchased these important automatic-telephone patents for a large sum. Since the expiration of the fundamental Strowger patent the Lorimer-Lundquist patents are regarded as of much importance by those conversant with the development of the art of automatic or semi-automatic telephony. One of them relates to the automatic selection of an idle trunk between telephone exchanges.

The Lorimer-Lundquist Company represents apparently a coalition of the Lorimer Automatic Telephone Company, the American Machine Telephone Company and the Globe Automatic Telephone Company. The Globe or Lundquist interests controlled the patents of Mr. F. A. Lundquist and the Lorimer interests those of Mr. G. W. Lorimer. Certain patents of Mr. M. E. Richardson appear to have been involved also. The legal situation is a rather complicated one, but the fact of principal public interest is that the patents have been purchased by the Western Electric Company, which is controlled by the American Telephone & Telegraph Company, at a price which indicates the apparent importance attached to automatic telephony by the Bell interests.

THE LONG ACRE CASE IN NEW YORK.

Arguments will be heard in March by the Appellate Division of the New York Supreme Court in the case affecting the Long Acre Electric Light & Power Company, which is trying to establish itself in business in New York City. A memorandum in opposition to the motion to dismiss the writ of certiorari secured on Nov. 21, 1911, by the New York Edison Company was filed in the court recently by Henry J. Hemmens and Morgan J. O'Brien, of counsel for that company. They argued that the obvious intent of the Legislature in framing the public service commissions law was to prevent the doing of the very thing that is here attempted to be done, namely, the invasion of the territory of the existing company, which is properly conserving the public interest and convenience, by a competing company after the enactment of the public service commissions law. They also declared that the Long Acre Company is in the position of a company having received a franchise which has never been operated and which is asking for permission not only to construct a plant but to exercise the privileges granted.

Corporations subject to such regulations as prevail now cannot at the same time, it is argued, be subject to competition under the law as it exists at the present time. If the New York Edison Company is to be regulated in such manner as it is now it should also be protected by the State against competition. If, however, competition is to be permitted then it should be relieved of such regulation and permitted to meet competition in competitive districts at competitive rates without reference to the rates in non-competitive districts.

The intent and object of the law as it exists to-day is that no new company shall be permitted to compete with the New York Edison Company unless a public need or necessity is shown therefor. The State must keep faith with the corporations which it has determined to regulate. The determination of the commission permitting the issue of bonds and stock by the Long Acre Company not only nullifies the public service commissions law but strips it of all force and permits an act in complete disregard of its intent and plain meaning. The commission by its order, instead of protecting the public, permits, the memorandum declares, a paper company to evade the law. It is therefore argued that the motion made by counsel for the Long Acre Company to dismiss the writ should be denied, or the application should be referred back to the Public Service Commission, First District, with directions to consider and act upon the question of public necessity and convenience.

The order of the court granting the writ was issued on petition of the New York Edison Company, which gave a history of the case. The commission originally denied the application of the Long Acre Company for permission to issue securities and denied a rehearing. Thereafter the Long Acre Company caused this determination to be reviewed by a writ of certiorari issued by the Appellate Division of the Supreme Court. That court reversed the determination and referred the application back to the commission for consideration and action. Subsequently the petition of the Long Acre Company was considered again by the commission. Before the re-hearing the public service commissions law was amended and the New York Edison Company appeared as an interested party under the amendment of 1910 to show that the franchise claimed to be owned by the Long Acre Company was never operated and used according to law, and also to show that no public necessity exists for a competing company. The commission granted the application of the Long Acre Company contrary to the objection of the New York Edison Company. The latter company thereupon applied for a rehearing by the commission and this was denied.

The petition further declared that the record showed that the Long Acre Company did not supply electricity to any customer previous to Jan. 1, 1908, and that that company had never attempted to carry on any but a pretended business and had never asked for permission to begin construction or to exercise its alleged franchise. It was also declared that none of the predecessors of the Long Acre Company had ever erected in the city of New York a pole, wire or lamp pursuant to a permit issued by any department of the city or otherwise.

The first determination made by the Public Service Commission was annulled because the Appellate Division considered that the Public Service Commission had misconceived the law. The court said in substance that the reasons for the denial of the application which were stated by the Public Service Commission were based on the underlying proposition that there should be no competition in the business of public lighting, as it was the general policy of the State to prevent such competition. The court said, however, that there was nothing in the public service commissions law relating to gas and electric companies to show that the right to determine whether such competition should be permitted had been delegated to the Public Service Commission. This statement was made because Section 68 of the public service commissions law, relating to gas and electric companies, differed from Section 53 of the same law, which was applicable to railroads.

The railroad law gave the right to the commission to determine the question of public convenience and necessity. No such right had been delegated with respect to gas and electric companies.

In June, 1910, however, the public service commissions law was amended and Section 68 was re-enacted so as to contain all provisions which had theretofore been found in Section 53. Since that date, therefore, the Public Service Commission has had the right to determine whether competition should be permitted against an existing and operating electric light company. This is the question that is now before the courts for determination.

Electric-Switch Litigation.

The United Circuit Court of Appeals sitting at New York has rendered a decision dismissing an appeal from a lower court in a case alleging infringement of a patent (No. 633,771) granted Sept. 26, 1899, to Gilbert Wright and Christian Aalborg and covering an improvement in switch mechanism. The lower court has dismissed the bill alleging infringement, and this action was affirmed by the upper court.

The opinion states that the record shows clearly that at the date of the alleged invention of the switch the use of a laminated contact member with beveled ends was old in the art. The departure from the gripping engagement of the old knife contact and the substitution therefor of face-to-face contacts are shown by several patents older than the one in suit. Moreover, pivoted supporting arms, actuating levers and various forms of connections for bringing the movable member into contact with the stationary members and for breaking the arc are shown in earlier patents. The court held that, with the structures in the prior art shown by the record, mechanical skill was quite sufficient to obtain any advantages disclosed by the patent, the conclusion being that the elements of the claims considered separately are old and that nothing in their combination disclosed invention.

DR. STEINMETZ ADDRESSES BOSTON LUNCHEON CLUB.

Three hundred and fifty-two electrical men assembled at the American House, Boston, on Jan. 26, at the second weekly meeting of the Luncheon Club branch of the New England Section of the N. E. L. A. to listen to an inspiring address on "Recent Progress in Electrical Engineering" by Dr. C. P. Steinmetz, of Schenectady, N. Y. Chairman L. D. Gibbs opened the meeting with the announcement that the assemblage constituted the largest mid-day business gathering of electrical men ever brought together outside a convention, and presented Dr. Steinmetz as a gentleman, an engineer and a scholar who needed no introduction in electrical circles. As the distinguished guest stepped upon the platform a storm of cheers bore eloquent testimony to the regard in which he is held in New England.

Dr. Steinmetz sketched in bold strokes the latest developments in prime movers, generators, long-distance transmission, lightning protection, utilization of electric power, heating and lighting applications, closing with a brief reference to the possibilities of wireless telegraphy and telephony. He pointed out that the development of the high-powered steam turbine has driven everything before it in the design of great plants, although the reciprocating engine still holds in small and medium-sized units. The efficiency in fuel consumption and the economy in space of turbines of 20,000-hp to 30,000-hp rating are of fundamental importance. Gas-engine development has been rather a disappointment within the last year or two. Dr. Steinmetz emphasized the great reliability and simplicity of the induction generator, whose emf depends upon the voltage of the system in connection with which it operates, and which delivers power as supplied by its prime mover, without the need of complex controlling devices, switches, regulators or an exciter. Remote control can readily be effected by a nearby power station equipped with synchronous generators.

Discussing long-distance transmission, Dr. Steinmetz reviewed the limitations of pin-type insulators and pointed out the great advances resulting from the use of suspension insulators, particularly beyond 40,000 volts. The principle of breaking up the line voltage in a number of insulating steps is one of great value. So far as insulation goes, transmissions of from 200,000 to 300,000 volts are now possible, but corona difficulties are still to be overcome. The profound study of corona during the past two years is bearing fruit in a knowledge of its laws, which will doubtless lead in time to transmissions successful far beyond present voltage limits. By means of the aluminum-cell arrester the problem of lightning protection has now been reduced to terms of cost versus reliability. The occurrence of excess voltage inside the circuit is handled by the same method, and the dangers of excessive currents are obviated by the installation of reactance coils. As yet the problem of protection against high frequencies is relatively unsolved. Frequencies as high as 100,000 cycles per second may occur in large systems, and these are often highly destructive through their production of abnormal local potentials which break down units of insulation and produce short-circuits of highly explosive character. Dr. Steinmetz outlined the enormous range of motor sizes now in industrial service, as typified in the cotton mill and the steel mill. He contended that the field of electric power service is still exploited to but a small fraction of its possibilities, as indicated by the preponderance of the steam engine in existing installations.

Heat storage is an important point in connection with electric heating on a commercial scale, and the speaker emphasized the fact that in the case of many domestic heating applications the load-factor is often poorer than in lighting. A great advantage of electricity is its lack of need of ventilation or an air supply for successful operation. The efficiency of the electric heating application is far above that of the coal stove or gas range. Domestic heating demands require great rapidity of operation. It is a disadvantage to build such appliances for the lowest possible energy consumption. Improvement of the heating load-factor is desirable in the interests of cheaper production and consequent lower price.

Dr. Steinmetz touched upon the evolution of the metallized-filament lamp, and predicted that the wire-drawn tungsten unit will drive the carbon incandescent out of existence. Again, the tungsten lamp is more efficient than the old inclosed arc lamp. Referring briefly to flaming arcs, he said that the greatest need is the securing of the same life for less power in a given lamp rating. At a moderate increase in the maintenance cost we get ten times the former light for a given energy expenditure, but at the sacrifice of electrode life. This is useful in the case of large cities, but what is needed specially is a reduced cost of lighting, so that more units can be installed and wider areas illuminated. Present types of luminous-arc lamps give a bright light and burn for long periods, but are handicapped by being dependent upon direct current. It is hoped that an alternating-current luminous-arc lamp will soon appear. In closing, Dr. Steinmetz said that the world has only just begun the study of wireless telegraphy and telephony. The effect of very high frequencies upon adjacent power and lighting circuits is likely to lead to interesting problems. In wireless telephony we are free from the deceleration of articulation caused by line capacity. No spot on the earth can now be considered as electrically isolated, in view of developments in the wireless field, and the present genera-

tion is not unlikely to live to see the day when a man in the United States will call up a friend in Tokio or London and converse with him by wireless telephony.

MAINTAINING ELECTRIC SERVICE DURING FIRE.

The public is not often impressed with the full meaning of the word service as it is dispensed by most of the large electric-lighting companies and might perhaps overlook the outage of an arc lamp under conditions such as are illustrated herewith. Central-station companies, however, are keenly alive to their obligations for continuity of service at any cost, especially if the lamps are on the chief thoroughfare of the city as in the case illustrated, and the Philadelphia Electric Company was not to be outdone by the New York Edison Company, whose promptness in restoring service at the Equitable Building fire was noted in these columns a few weeks ago.

Ice-Coated Arc-Lamp Post on Market Street, Philadelphia.

A fire in Philadelphia recently wiped out Lubin's moving-picture theater, which was located on Market Street, not far from City Hall. The temperature was almost zero, as might be judged from the engraving, and naturally the arc lamp-post, being in front of the burning building, came in for its share of water and ice. Nevertheless, the lamps were in service that night, even though that portion of Market Street was not open to pedestrians. Moreover, employees of the company ran the elevator in the adjacent building for five hours for the convenience of the firemen during the conflagration in order that the post office adjoining the theater to the west might not be endangered. Incidents such as these pass unnoticed usually, and the company must be content with the satisfaction that arises from the consciousness of having performed work well under trying circumstances.

THE ELECTRIC VEHICLE IN BOSTON.

Unabated enthusiasm marked the continuation of the electric-vehicle campaign last week at Boston, two meetings being held in the interest of storage-battery trucks and pleasure equipments. At the regular Wednesday luncheon of the Boston Electric Vehicle Club advertising was discussed at length, with Vice-president E. S. Mansfield in the chair. To increase interest in pleasure cars it is planned to inaugurate a story-writing contest in which prizes will be offered by the Electric Vehicle Club interests for the best descriptions of trips starting from Boston and finishing in stated areas in close touch with the city. It is proposed to offer sums amounting to about $240 for first, second and consolation prizes in connection with trips of one-half day, one day and three days' (week-end) duration, beauty of scenery and comfort of travel being considered before speed. Accounts of the best trips are to be collected and published in a pamphlet which will be distributed to prospective owners of electric pleasure cars, and it is also proposed to award as an alternative prize a discount from the purchase price of any new electric vehicle which the winner may buy.

The regular meeting of the New England Section of the Electric Vehicle Association of America was held at the Hotel Thorndike, Boston, on Jan. 25. Mr. H. W. Moses, manager of the Boston 1912 Electric Show, outlined the architectural features of the exhibition as thus far developed. These include a large amount of brilliant display lighting within and without the Mechanics' Building, where the show will be held throughout practically the entire month of October, and the installation of illuminated arches on Huntington Avenue from Copley Square to Massachusetts Avenue. Mr. Chester I. Campbell, Boston, assistant manager of the show, emphasized the benefits of exhibitions. Much interest was aroused by an informal talk by Mr. H. F. Thomson, of the Massachusetts Institute of Technology, Boston, upon the research work being conducted by the electrical engineering department upon the cost of horse, gasoline and electric truck service, under the auspices of the Boston Edison company. The department is making a special effort to obtain data of scientific value, and has thus far secured returns from about ninety trucks. Sixteen cities have been visited and fifty-four firms called upon, aside from vehicle manufacturers, in the interests of the investigation. In Boston nineteen users of horses, gasoline and electric trucks have been seen, and material from them has been gathered. The data sheets of the research division are designed to facilitate the more thorough keeping of operating and expense records, and include such items as service details, age, cost, weight, style and equipment of vehicles, battery and tire installations, performance on the basis of mileage, time, trips, energy and weights handled, operating, maintenance and fixed costs, with general practice regarding the loading of vehicles, speeds and road characteristics.

The data secured are being analyzed as fast as possible, in the interests of determining the actual cost of horse, gasoline and electric transportation on an impartial basis. The work indicates that much more detailed figures must be kept in order to arrive at general conclusions so far as many individual installations are concerned. One interesting point brought out was a comparison of average speeds of a one-horse team and a 1000-lb. electric vehicle for twenty "wagon days" and eleven "truck days." On long runs the average speed of the horse-drawn outfit was 3.8 miles per hour and of the truck 8.8 miles per hour. The average speed while each vehicle was in motion was 6.8 miles per hour for the electric and only 2.6 miles per hour for the horse. Recording speedometers are now in service on a considerable number of Boston vehicles the service and costs of which are under the scrutiny of the department. Six days were recently devoted to timing observations of

the traffic conditions at one of the most congested railroad terminals in Boston, and it was found that the motor vehicle is instituting marked economies over the single and double-horse team in the time of arrival at doorways from a given starting point, in time of waiting to unload or to proceed, backing up and unloading. Among the figures discussed for specific cases were the following costs of service: For an electric vehicle, capacity 1000 lb., central-station service records covering thirty-two months, the age of the vehicle, showed that on a yearly basis running repairs cost $156, lubricants $15, electricity, obtained exclusively at garage, $278, sundries $14, chauffeur $571, battery renewals $252, tire renewals $126, overhauling $146, amortization $396, interest $57; total, $2,011. The costs of a 6000-lb. gasoline truck totaled $3,700 on a yearly basis, the costs being kept for eight months.

The advertising campaign on behalf of the electric vehicle at Boston resulted in a recent display section in a Sunday newspaper, in which it was emphasized that in the last five years the cost of oats per bushel in Boston has risen 11 per cent, the cost of corn 16 per cent, the cost of hay 24 per cent, and that of horses 100 per cent, while electricity has dropped in maximum price by 39 per cent and electric trucks have increased 25 per cent in efficiency. The Boston Edison company has expended $104,424 to date in the purchase and exploitation of the electric vehicle.

USE OF THE DRAEGER PULMOTOR IN CHICAGO.

For several months the Commonwealth Edison Company, of Chicago, has possessed a Draeger pulmotor, or oxygen machine, which is designed to establish automatically artificial respiration of oxygen, and to be used in cases of asphyxiation, drowning or resuscitation from electric shock. It is interesting to note that the machine, which is made in Germany, was purchased in the first place in response to a suggestion made by an employee, as the company gives prizes at intervals for the best suggestions for improvement of the service. The apparatus has been used twice in the case of men overcome by electric shock. It was not successful in either case, but, as in both cases the patient had probably been dead for an hour or more, these cases are not to be considered as fair tests of the efficacy of the machine. It has gradually become known, however, principally through physicians, that the electric-service company is in possession of this machine, and in a number of recent cases it has been used where persons have been overcome by inhaling illuminating gas. In these cases of asphyxiation the results have been very gratifying, and in several instances it is believed that the persons operated on would have died had it not been for the use of the machine. The successful use of the machine in cases of gas suffocation has attracted much attention through the newspapers, and now the machine is in frequent demand in cases of gas asphyxiation, while the company has received many inquiries from out-of-town sources in relation to the use of the device.

The machine, which was described in the *Electrical World* of April 6, 1911, consists essentially of a tank of oxygen under a pressure of 3000 lb. to the square inch, a reducing valve to step down this high pressure to 2 lb. or 3 lb., an aspirator operated by the compressed gas for the purpose of producing a suction, an automatic valve mechanism to control the aspirator, a face cap covering the nose and mouth of the patient, and flexible tubes connecting the aspirator and the face cap. When the cap is adjusted and the valve opened, admitting the compressed oxygen to the mechanism through the reducing valve, the oxygen under pressure will fill the lungs and will then be drawn out again by the suction induced by the aspirator and exhausted into the air. This process is repeated about ten times a minute, and may be continued automatically until the oxygen in the tank is exhausted. A tongue tractor is carried with the apparatus, which is all inclosed in a wooden box about the size of a large suitcase. The tongue tractor or forceps is used to pull back the tongue so that free access may be had to the windpipe.

In the two cases where the machine was tried in electrical fatalities the subjects, as above stated, were probably dead before the apparatus arrived. Artificial respiration was established, however, and continued for an hour or more before the task was abandoned. In one of the cases a fireman was killed after contact with a 110-volt circuit, although it is thought that there must have been some other contributing cause of death. In the other case a workman was killed while testing a dynamo in a factory and using alternating current at about 1000 volts. In the numerous recent cases of gas suffocation where the company has been called on the subjects have been usually found unconscious but breathing slightly. So far, without exception, they have been revived after breathing the oxygen for a few minutes. In cases where the patient is able to breathe a separate attachment permits administering the oxygen without the intervention of the machine for forcing artificial respiration. The apparatus is kept in the load dispatcher's office at the headquarters of the chief operating

The Draeger Pulmotor.

engineer. Two or more men are always on duty here. When a call is received asking for the apparatus it is referred promptly to the load dispatcher, who summons an automobile and proceeds with all possible haste to the address given. The general superintendent of police has provided the company with a letter permitting fast driving in these emergencies. Many of the calls come from physicians, and those doctors who are familiar with the machine are almost unanimous in its praise. The company makes no charge for the use of the apparatus for life-saving purposes.

Perhaps the Commonwealth Edison Company is the first central-station company to make use of the pulmotor. The machine is, however, familiar in Germany and to some extent in this country by its use in mine accidents, and it has been recommended by the Bureau of Mines of the United States government. While the Chicago company has only one in service at the present time, other machines have been ordered. The foreign manufacturer has an American agency in Pittsburgh, and up to the present time the compressed oxygen is received from this source. The accompanying illustration represents a demonstration of the apparatus in Chicago. One of the load dispatchers of the electric-service company is seen at work applying the

apparatus to an apparently unconscious man. The operator holds the tongue tractor in his right hand and the tubes connected with the face mask in his left hand. The entire mechanism is shown in the box at the right.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS.

The Western Association of Electrical Inspectors met at Milwaukee, Wis., Jan. 23 to 25, the first day's session being reported by telegraph in the *Electrical World* of Jan. 27. On Wednesday morning the members visited the West Allis works of the Allis-Chalmers Company, inspecting the factory and witnessing tests on motors and equipment. After luncheon, which was served in the rooms of the Allis-Chalmers Club, the convention resumed its sessions in the auditorium. Preceding the regular program, addresses were given by several officials of the manufacturing company. Mr. C. E. Lord, patent attorney of the company, spoke on engineering personality behind apparatus, Mr. Lewis Strothman described high-pressure systems and fire-protective devices, Mr. R. B. Williamson discussed induction-motor operation and construction, and Mr. H. W. Cheney explained the use of starters.

Mr. W. G. Middleton, Chicago, followed with a paper on "Electrolysis," especially as affecting the strength of reinforced-concrete structures. An electrolytic survey with a voltmeter he compared to a hydraulic survey, the effort in both cases being to drain from the higher to the lower potential. Grounding can be used to drain off the vagrant currents, or generators may be installed to pump them away as would be done hydraulically. Effects ordinarily ascribed to pure corrosion are now credited to electrolytic action by some authorities, although others accept the carbon-dioxide, hydrogen-peroxide and biological theories. In the process of oxidization the presence of hydrogen appears to be almost more significant than that of hydrogen. Pure homogeneous irons resist rusting. Ingot iron has been produced with a purity of 99.985 per cent. The sherardizing process protects the iron by adding a coating of zinc alloy. Magnetic oxides also form a protective coating. A "passive state" can be imparted to iron by treating it with a strong oxidizing agent.

The speaker in the course of his remarks next referred to the electrolysis of reinforcing steel in concrete. Concrete cubes containing iron bars have been split in one week by a current of 1 amp. A current of 0.1 amp similarly splits them in two months. Cinder concrete does not suffer in this way. Alternating current has no destructive action. Paints have been applied to protect iron against corrosion. Linseed oil, however, tends to saponify, but a good coating is provided by mixing it with ground red lead. A pinhole in such an insulating coat will concentrate all the destructive action at this one point.

The closing session of the regular program was held Thursday afternoon. Mr. Franklin H. Wentworth, secretary of the National Fire Protective Association, related "Some Reminiscences of a Pioneer Electrical Inspector" and discussed the fire hazard. Fire losses for January, 1912, he said, have reached more than a million dollars a day. The average per capita loss in this country is $3 a year; in Europe it is 33 cents. Boston's fire loss is seven times that of Glasgow, a city of about the same size. Chicago's loss is twenty times Berlin's, in spite of equal population. Berlin's fire department costs $300,000 a year, Chicago's costs $3,000,000. This heavy tax is indirectly paid by every citizen, and the average American family of five pays in loss and fire protection $30 a year. Mr. Wentworth suggested inserting in the association *Bulletin* a chapter on interesting electrical fires and invited reports from the inspectors present.

Motor-driven moving-picture machines were next discussed by Messrs. James Bennett, Montreal; W. S. Boyd, Chicago; Leon Taylor, Dallas; Waldemar Michaelson, Omaha, and F. L. Daniels, Indianapolis. A special committee was asked to investigate the safety of motor drive with certain projecting machines. Inspection of electrical equipment of traveling shows was discussed by Messrs. Leon Taylor, B. W. Clark, Detroit; F. G. Dustin, Minneapolis, and V. H. Tousley, Chicago. A proposal to prohibit leather-headed nails, requiring screws for attaching split knobs and cleats, provoked interesting discussion by Messrs. James Bennett, R. J. Swain, St. Boniface, Manitoba; H. E. Bloomer, Milwaukee; Mr. Aldrich, Chicago; H. B. Long, Nashville, Tenn., and W. S. Boyd, Chicago. By a close vote the code committee was asked to prohibit the use of nails.

Mr. W. J. Canada, Denver, Col., presented an abstract of his paper on "Grounding of Conductors and Conduit." Among those taking part in the discussion were Messrs. F. G. Dustin, F. L. Daniel, V. H. Tousley, Leon Taylor and W. Michaelson. A full abstract of Mr. Canada's paper will be given in these columns. The general idea developed in the discussion was that water-works are the principal obstacle in the way of universal adoption of water-pipe grounds.

A unanimous vote of acceptance was given the report of the nominating committee, Messrs. Dana Pierce, Chicago; L. A. Barley, Oklahoma City, and H. G. Young, Streator, Ill., and the following officers were declared elected for 1912: President, W. J. Canada, Denver, Col; vice-presidents, B. W. Clark, Detroit, and H. M. Maxwell, Dayton; secretary-treasurer, W. S. Boyd, 76 West Monroe Street, Chicago. The executive committee comprises Messrs. James Bennett, chairman; V. H. Tousley, Chicago; W. B. Hubbell, Cincinnati; E. Anderson, Minneapolis; H. T. Wreaks, New York, and H. C. Young, Streator.

Mr. W. J. Canada, the newly elected president of the association, was born at New Haven, Conn., in 1881, and was graduated from the Sheffield Scientific School of Yale University in 1902. After an apprenticeship course in the General Electric Company's shops Mr. Canada became superintendent of motive power for the Appleyard lines between Columbus and Dayton, and was afterward associated with the Ohio inspection bureau at Dayton. He is now holding the position of electrical and hydraulic engineer for the Rocky Mountain Fire Underwriters' Association, with headquarters at Denver. The secretary-treasurer, Mr. W. S. Boyd, has held that position from the formation of the association, and can be credited with much of the uniformity in interpretation of Code rules which now largely prevails throughout the West and Central States.

In addition to the factory inspection and luncheon at the West Allis works of the Allis-Chalmers Company, the association also visited the Cutler-Hammer Manufacturing Company's plant and witnessed tests of control devices. Tuesday evening a handsomely appointed banquet was served, Wednesday there was a theater party, and on Thursday the convention visited the Pabst brewery, where a luncheon was served. Messrs. H. E. Bloomer, August Rehhan, George F. Rohn, Albert Peterman and F. J. Meyer composed the efficient local committee on arrangements for the convention. The 1913 convention of the association will be held Jan. 28 to 30, at St. Louis. The National Electrical Code Rules and their application will be specially considered by committees and sub-committees during this year.

A fact worthy of note is the earnestness and broadness characterizing the activities of the association and the growing evidence of constructive co-operation with manufacturers, lighting companies and contractors, where before the association was formed seven years ago there was room for much criticism of inspectors for narrowness and provincialism.

BUFFALO MEETING OF THE EMPIRE STATE GAS & ELECTRIC ASSOCIATION.

A notice of the meeting of the Empire State Gas & Electric Association held in Buffalo on Jan. 24 was published in these columns last week. About thirty-five representatives of companies were present at the morning and afternoon sessions, which were held at the Hotel Iroquois. The subjects under discussion were joint use of poles and railroad crossings. Mr. C. G. M. Thomas, Long Island City, New York, presided.

Mr. C. H. B. Chapin, the secretary, read the call for the meeting. The recommendations made by the executive committee were approved. The executive committee recommended to the favorable consideration of the members the specifications for overhead-line construction submitted by the committee on overhead-line construction of the National Electric Light Association. The committee also recommended that the matter of the form of agreement for the joint occupancy of poles be referred back to it with instructions to submit forms for adoption later.

Mr. B. H. Paine, Buffalo, opened the discussion on the subject, urging that the recommendations of the executive committee be approved. He gave an account of the work of the committee on overhead-line construction of the National Electric Light Association, of which he is a member. Mr. Ernest H. Davis, of Williamsport, Pa., who appeared for one of the member companies, opposed the adoption of the resolution.

Mr. William McClellan, engineer of the Public Service Commission, Second District, suggested the creation of a national committee to formulate specifications on this subject which would be satisfactory to each class of companies concerned. This committee should include representatives of the electric lighting and power, steam-railroad, electric railway, telegraph, telephone and signal interests.

Mr. Farley Osgood, Newark, N. J., chairman of the committee on overhead-line construction of the National Electric Light Association, stated that this committee had been continued and would be pleased to give full consideration to any recommendations which might be made for modifications and specifications.

The executive committee is prepared to take up the question of forms of agreement in due course.

NORTHWESTERN CEDARMEN'S ASSOCIATION.

Composed of producers of white-cedar poles and other cedar products in the States of Michigan, Wisconsin and Minnesota, the Northwestern Cedarmen's Association has a definite relation to the buyers of cedar poles, who are mainly telephone, telegraph and electric-service companies. The sixteenth annual convention of this association was held in Minneapolis on Jan. 23 and 24, with President T. M. Partridge, of Minneapolis, in the chair. Secretary McKinney presented a report for the year 1911, in which he said that the twenty-eight member companies of the association were beginning the present year with practically the same amount of stock on hand as on Jan. 1, 1911. The following paragraph from the secretary's report is of interest to pole consumers:

"Using the report of the United States government in the consumption of white-cedar poles in the United States, we figured that during the year 1911 the consumption of poles 16 ft. in length and up would be about 2,385,000, and, using that as a basis, if the association furnished the bulk of the stock there should not be much over 650,000 poles of from 16 ft. up in the hands of association members on Jan. 1, 1912. There is no doubt the consumption of poles for the year was greatly below this estimate. We find that, while we shipped 1,659,920 poles of from 16 ft. up, we still have on hand 1,271,881 pieces. Had the consumption for 1911 come up to our estimate we should probably not have had over 700,000 poles on hand. Our figures show that there are 118,435 fewer poles of from 16 ft. up on hand than on Jan. 1, 1911, and only about 44,000 fewer of from 20 ft. up, which is very much less than our estimate and shows that, while the consumption was less than our estimate, the production was more than, or at least up to, the estimate."

At a later session Messrs. T. P. Bradley, of Duluth, and A. T. Naugle, of Chicago, reporting for the pole committee, said that pole stocks were pretty well cleaned up, and, although the statistical report showed that the members of the association had about as much stock as a year ago, practically all the poles were held by association members at this time, whereas a year ago there were many poles in the hands of producers who did not report to the secretary.

Relating to the official inspection of poles, it was determined that the rules should provide that poles 20 ft. and longer should admit of "short measure" to the extent of 1 in. for each 10 ft. and of "long measure" to the extent of 6 in.

Considerable attention was paid to the subject of mutual fire insurance, and members representing forty-two separate yards signed a paper agreeing to give serious consideration to an inter-insurance agreement when the plan shall have been worked out by a committee of which Mr. E. L. Clark, of Minneapolis, is chairman.

Officers were elected as follows: President, Mr. Thomas P. Bradley, Duluth; vice-president, Mr. W. C. Moss, Minneapolis; treasurer, Mr. W. B. Thomas (re-elected), Manistique, Mich.; other directors, Messrs. H. S. Gilkey and L. A. Page, Jr., of Minneapolis; Mr. J. W. Benham, of Chicago, and Mr. M. K. Bissell, of Escanaba, Mich. Afterward the board of directors re-elected Mr. H. H. McKinney, 743 Lumber Exchange, Minneapolis, secretary for the ensuing year. Mr. Bradley, the new president, is the general manager of the Duluth Log Company.

SPREADING THE GOSPEL OF FAIR PLAY.

Speaking on "Regulation" before the Electric Club of Chicago on Jan. 24 Mr. H. M. Byllesby mentioned the early difficulties encountered in the art of electric lighting in regulating the potential of electrical energy under service conditions. Many inventors worked on the solution, each in his own way, and the method by which the problem was finally solved was a composite of the efforts of all. Mr. Byllesby drew a comparison between this physical regulation problem of thirty years ago and the problem of to-day confronting the electrical industry, which is itself being regulated. The solution of the early difficulty suggests the hope that the broader and more far-reaching problem of regulation by public-service commissions may be solved likewise. It is idle to deny that the attitude of the public is antagonistic toward public-service corporations, and this is largely due to the too dignified silence of men connected with such corporations. However, many opponents of the corporations seem to have no common ground in making their attack, unless it is the destruction of the corporations. The speaker exhorted his hearers to take their place in studying the questions of the hour and to oppose the fanatics on either extreme of the question of regulation—that is, those who are fanatically in favor of corporations at all hazards as well as those who are fanatical in seeing no possible good in corporations.

Regulation has come to stay, but the public-service corporations ask that it be worked out by fair-minded men intending to do exact justice and also possessing a knowledge of the conditions that obtain. Regulation should be exercised not only by men of fundamental honesty but

also by those who know what they are regulating. The old-time characteristic of silence on the part of employees of public-utility companies must be supplanted by an outspoken demand for fair play that the demagogue and fanatic may be dislodged. Men of character who know whereof they speak must step in and take these matters into their own hands. Mr. Byllesby told the members of the club that their influence was far greater than they imagined, and he made an earnest plea for legitimate agitation on the subject. It is the first step in good citizenship to take an interest in the problems of the hour, to the end that the ideals of justice and fair play may be carried forward.

ELECTRICITY IN AGRICULTURE.

In a lecture delivered before the New York Electrical Society on Jan. 25 Mr. E. P. Edwards, Schenectady, presented many interesting facts relating to the use of electricity in agriculture. He reported the results of an investigation showing that the grinding of 4000 bushels of corn cost a total of $186 with electricity at 6.6 cents per kw-hour, while hauling this corn to and from the mill, 2 miles distant, and paying the miller's charges for grinding would have cost the farmer $308. The more general use of electricity on the farm would be promoted by abandoning the special low-voltage generating equipments for standard-voltage apparatus with which all types of electrical devices can be employed economically.

Mr. Putnam A. Bates, New York, exhibited a large number of slides showing the wide variety of electrical devices developed for farming service, including plows, threshers, milkers, incubators, refrigerators, feed cutters, grinders, pumps, heaters and machine tools. Attention was directed to the extensive use of electricity in the rural communities covered by the circuits of the Northern Colorado Power Company, as described in the *Electrical World* for Sept. 30, 1911.

Dr. S. S. Wheeler, New York, claimed that electrical apparatus for farmers should be of the simplest possible kind and require no expert attention whatsoever.

Mr. W. R. Hutchinson, Orange, N. J., described the isolated-plant voltage regulator now being developed by Mr. Thomas A. Edison for maintaining a constant voltage at the lamps in spite of fluctuations in the voltage of the storage battery or generator. This regulator operates to vary the amount of resistance in series in the circuit between the lamps and the source of supply according to the current in circuit and the voltage at the supply end.

CHURCH AND AUDITORIUM LIGHTING.

Mr. H. B. Wheeler, chief engineer of the National X-Ray Reflector Company, was the speaker at the meeting of the Chicago Section of the Illuminating Engineering Society held on Jan. 18. His subject was "Church and Auditorium Lighting," and he gave an illustrated description of the installations and tests of indirect lighting in the Eighth Church of Christ, Scientist, in Chicago, the edifice of the North Chicago Hebrew Congregation and the Village Club at Glen Ellyn, Ill. Mr. Wheeler remarked that auditorium lighting by indirect methods is only a few years old, but there are probably 100 churches and large auditoriums at present equipped with the indirect-lighting system. Pictures were shown of the interior of St. Thomas Aquinas' Church, on the West Side, Chicago, and the First Baptist Church of Rome, N. Y., both having indirect lighting. The former has an auditorium 66 ft. by 85 ft. and is unusual from the fact that it has a 12-ft. ceiling. The fixtures here are plain and each one is equipped with four 100-watt tungsten lamps. The energy consumption is 0.6 watt for each square foot of floor surface illuminated. In the Rome church the consumption is 0.75 watt per square foot.

The Eighth Church of Christ, Scientist, is one of the handsomest church edifices in Chicago. It is a domed structure and the main auditorium under the dome has an area of 3600 sq ft., with side openings or alcoves of 960 sq. ft. each. The height from the floor to the ceiling of the dome is 50 ft. A very large central fixture for indirect lighting is suspended beneath the dome. It contains twenty 250-watt lamps, each provided with a concentrating reflector. This fixture is 7 ft. in diameter and over 3½ ft. deep and is one of the largest indirect-lighting fixtures ever installed. It is lowered by a windlass for cleaning or replacing the lamps. In the side alcoves, if they may be called such, there are a number of other indirect-lighting fixtures, some containing five 100-watt lamps and some containing six lamps of the same size. The reflectors in all cases are of glass and of the concentrating type, silver-plated and with corrugated surfaces.

Tests have been made in this church to determine, if possible, the efficiency of the installation, that is, the percentage of the total lumens available at a plane 30 in. from the floor to the total lumens produced by the lamps. Photometric measurements were made at eighteen stations and corrected for lamp voltage. The efficiency, subject to some possible further corrections, was stated to be 26.3 per cent. Taking the main auditorium under the dome and the single large fixture, the efficiency of the lighting was figured out at 33.4 per cent. The results, however, are approximate. The energy consumption was about 2.36 watts per square foot with all the lights on, and about 1.45 watts with only the lamps in the central fixture burning. However, these figures refer to an assumed pressure of 117 volts. Actually, the instrument readings showed 101 volts at the time of the test, so that the energy consumption with all lamps burning was 1.76 watts per square foot, and 1.21 watts with only the central fixture in use.

The church of the North Chicago Hebrew Congregation has a barrel ceiling with galleries on each side. The principal lighting consists of 100-watt lamps in twenty-six individual helmet reflectors concealed in a cove at the springing point of the arch of the ceiling on each side. There are thus fifty-two helmet reflector lamps in all. Under the galleries there are six indirect-lighting fixtures, each inclosing five 100-watt lamps. The distance from the floor to the highest point of the ceiling is 52 ft., and the height of the ceiling under the galleries is 30 ft. Preliminary tests on a 117-volt basis show great uniformity of lighting. About 2.5 ft.-candles was recorded at the hight point of the curve. In both of these church installations the congregations are well satisfied and there is no complaint as to reading in the pews.

The Glen Ellyn village hall is a pure white interior, furnishing ideal conditions for indirect lighting. Here there is a 15-ft. curved ceiling sloping to 12 ft. on the sides. Three fixtures are installed on a central line, each containing seven 100-watt lamps and hanging 60 in. from the ceiling. The room is 40 ft. by 60 ft. On a 110-volt basis the average ft.-candles was found to be about 4.45 at an energy consumption of 0.87 watt per square foot.

Mr. Arthur J. Sweet, of Newark, Ohio, answering some questions which were asked as to the relative efficiency or cost of energy with direct as compared to indirect lighting, gave in advance figures for some exhaustive tests which he has been making, which are to be given in a paper before the society next month. He said that in a small room having a ceiling with 60 per cent coefficient of reflection and walls with 40 per cent coefficient of reflection the percentage of the lumens generated which are effective on the working plane—that is, the efficiency—is 30 per cent. With a direct-lighting system giving equal uniformity employing prismatic reflectors in the same room the efficiency would

be 55 per cent. For these conditions, therefore, the ratio of efficiencies of the two systems would be as 30 to 55. With very light walls and ceilings indirect lighting efficiencies may go as high as 42 to 45 per cent. He said that his paper would show that the reduction in illumination by the use of dark-colored walls is more than offset by the increase in visual acuity or ability to see clearly with the darker walls.

PROPOSED WATER-POWER LEGISLATION IN NEW YORK.

The joint legislative committee appointed last year to investigate and report on problems of water storage and utilization of the available power has presented its report to the New York Legislature. The committee recommends specifically three constitutional amendments—one to permit the flooding of as much of the forest preserve as may be necessary in the construction of storage reservoirs, one to permit power companies engaged in the transmission of electrical energy to municipalities to cross any portion of the forest preserve for proper compensation, and one declaring that development of the water-power of the State is a proper government function and that the right of eminent domain is proper in connection with it. It recommends amendments to the canal law and the conservation law to enable the State to utilize the surplus canal waters and where necessary to build power plants and transmission lines for the sale of hydroelectric energy, and the enactment of any other legislation necessary to carry out the general conservation policy outlined in the report.

It is recommended that whatever water-power is developed by the State should be sold at current market rates and not in competition. The committee holds that the State's water or water rights should be conserved and developed to the maximum point of commercial efficiency and every encouragement should be given to the development of individual rights, and that no further grant of water-power privileges or rights to State water should be given except for limited periods with provision for adequate compensation to the State. Revocable grants of water rights heretofore made by the State should be revoked, but "where the grants of the State have been made absolute and without any provision for their revocation, such rights should be regarded as sacred and inviolable." The State's watersheds should be improved and reservoirs be built at the headwaters where commercially practicable for the impounding of storm waters to regulate the flow of rivers.

PUBLIC UTILITIES COMMISSION PROPOSED FOR DISTRICT OF COLUMBIA.

Two bills are pending in Congress to confer upon the commissioners of the District of Columbia the duties and powers of a public-utilities commission. The first was introduced in the Senate by Senator Gallinger, of New Hampshire, on Dec. 14, 1911, and the second in the House of Representatives by Congressman Oldfield, of Arkansas, a week later. The bills are similar, but differ in some particulars. The commissioners of the District have approved the Gallinger bill, except that they object to having all the expenses of the commission (about $40,000 a year) paid from the revenues of the District. They ask Congress to assume half the expense. As analyzed by the District commissioners, the essential differences between the bills are as follows:

"The Senate bill, Section 6, adopts in a modified form the Maryland provision for valuation. The House bill, Sections 6 and 7, adopts the Wisconsin provision. According to the Senate bill the 'fair value' is to be ascertained.

"The House bill requires that there be ascertained, in addition to the fair value, the investment cost and the cost of reproduction. Now, the Supreme Court has declared that, among other elements entering into the fair value which it states is 'the basis of all calculations as to the reasonableness of rates,' are the original cost of construction and 'the present as compared with the original cost of construction.' In other words, it would seem that the Senate and House bills attain the same end in the matter, although by slightly different methods. The House bill has the advantage of being more specific; the Senate bill has the advantage of greater elasticity.

"With respect to stock and bond issues, again it may be said that the House bill adopts the Wisconsin provision and is very specific. The Senate bill, though less specific as to the manner of control, appears to confer upon the commission ample power to exercise all control that the House bill contemplates."

One of the most interesting provisions of the House bill is the last section, which reads as follows: "It shall be the duty of the commission in fixing and determining rates, in directing extensions and improvements, and in general when making requirements under the provisions of this act that involve expenditures by or lessen the receipts of public utilities, and notwithstanding any other of the provisions of this act, having in mind the public interest, to require the utmost of the public utility that will not trench upon its constitutional right to earn a fair net return upon the fair value of its property used for the convenience of the public."

The definition of the term "electrical corporation" in both bills is of interest. Such a corporation is held to include every person or corporation or receiver controlling, operating or managing any electric plant in the District, including any hydroelectric plant, "except where electricity is made, generated, produced or transmitted by a private person or private corporation, on or through private property, solely for its own use or the use of its tenants, and not for sale to or for the use of others." This definition would bring most of the "block lighting" plants in large cities under regulation.

INVESTIGATION OF DEMAND INDICATORS IN MASSACHUSETTS.

The Massachusetts Gas and Electric Light Commission has issued an exhaustive report to the Legislature upon the subject of demand indicators, as provided by a recent enactment. The object of the investigation was to determine the expediency of use of such apparatus. Prof. F. A. Laws, of the Massachusetts Institute of Technology, was retained by the board to make an examination into and report upon the mechanical and technical features of these appliances and a series of tests of Wright demand indicators, which are largely used by the Edison Electric Illuminating Company of Boston. It appeared that sixty-nine companies and twenty-three municipalities had no demand indicators in use on June 30, 1911. Twelve companies and four municipalities had 11,613 demand indicators in service on that date, and of these 10,745 were owned by the Boston Edison company. Of the indicators in use, 11,447 were of the Wright type, ninety-five were of the Ingalls relay type, and seventy-one of the General Electric type. The board considered the so-called excess indicators used in residence lighting as without the scope of the inquiry. Of the organizations using demand indicators, ten reported that these appliances were tested before being installed. The Boston Edison company tests before installation and returns 25 per cent of the instruments yearly to its laboratory for verification and repairs. Last year this company tested 2830 indicators in regular routine and made a total of 4184 tests.

The tests of Professor Laws covered eighty-one Wright indicators of from 5-amp to 300-amp rating. At 20 per cent load 44.5 per cent of the indicators registered high, the average excess being 13.5 per cent; 30.9 per cent registered low, and 24.7 per cent were correct. The average excess registration of indicators that registered correctly and too much was 8.7 per cent. That is, of the indicators tested at 43 per cent load fifty-eight were correct, fifteen were too high and eight too low, and at 90 per cent sixty-six were correct, eleven too high and four too low, assuming a reading within 5 per cent to class an indicator as being correct.

An important part of the board's report deals with the relation of the demand indicator to differential rates. The commission points out that there is no occasion for the use of such apparatus except to secure, through the relation of consumption to demand, prices lower than the standard or ordinary prices charged by the company. The board infers that 70 per cent of the Boston Edison company's customers must pay the maximum net price and therefore cannot take advantage of the differential rates. The large majority of customers are dependent on the companies for their supply, but are not directly interested in the demand indicator except as, by its use or by the prohibition or restriction thereof, a lower maximum price for electricity may be secured to them. In 1908, after an investigation of the Boston Edison rates, in the course of which the demand system was fully explained and discussed, the board, while unable to accept the company's theory in justification of differential rates, recognized the commercial necessity in the present development of the industry of making prices for large or long-hour users of electricity, whether for lighting or motor service, sufficiently low to attract business.

The problem before the company was to increase its output without a proportionate increase in investment. The board at that time made no recommendations as to the differential features of the company's schedules, but "permitted a continuance of certain differences in prices, not as a permanent policy, but until the uniform rate recommended can from time to time be safely reduced so low as to be in itself an encouragement to the unrestricted use of electricity for all purposes." In the present report the commission states that it has found no sufficient reason for changing these views and that it has pursued the policy of forcing reductions in the maximum prices at which any person in the territory occupied by any company may be supplied with electricity for any use. At the same time it has as consistently declined either to direct changes in, to indorse or to condemn differential prices offered by the companies, and has insisted only that all prices shall be open to all who may apply for service and that special and secret rates, direct or indirect rebates or preferences shall be discontinued. The central-station interests seem agreed upon the present necessity for differential rates and yet there is no general agreement among them as to the theory or practice upon which the making of such rates should be based.

The board believes that experience is as yet insufficient for reaching any final conclusion as to the expediency of prohibiting or restricting differential rates. "The use of demand indicators should therefore not be prohibited or restricted, although the board is emphatically of the opinion that it is not in the public interest that any legislative sanction shall be given to differential rates." The report closes with the recommendation that the jurisdiction of the board be extended to cover demand indicators, so that the provisions of the statutes by which a customer of an electric-lighting company may apply to the commission for testing may be utilized in relation to such indicators with a penalty for discovered inaccuracies in the reading. The full report will in the near future be printed as a public document.

PUBLIC-UTILITY LEGISLATION IN WISCONSIN DURING 1911.

The Wisconsin Legislature of 1911 passed a number of public-utility measures, many of the popular type, which must be tested by future experience. A review of this utility legislation was given by Mr. Arthur W. Fairchild, attorney, Milwaukee, before the Wisconsin Electrical Association at Milwaukee, Jan. 18.

Chapter 596 altered and amended all franchises, licenses and permits granted before July 11, 1907, to be "indeterminate permits" within the terms and meaning of the public-utilities law and subject to the terms of that law. The effect of this measure on the financing of utilities is problematical, although investors generally are expected to feel that their money is safe under such permits. The constitutionality of this act is still a matter of discussion and doubt, although certain recent tendencies in the Wisconsin courts indicate that it will be sustained. Chapter 652 was the "water-power act," which has attracted the lively interest of many operators in the State. The question of its validity is now under advisement by the Supreme Court. The decision when rendered will be of great moment, fixing the rights, interests and responsibilities of water-power owners and users. Chapter 217, arising out of a situation at Green Bay, declares that no franchise or indeterminate permit shall be declared invalid following the surrender of the utility property in good faith and provided that the franchise was not improperly obtained. Chapter 14 was designed to correct a situation at Kenosha and provides that heat, light, water and power franchises granted by virtue of an ordinance prior to the passage of the act shall be confirmed. The so-called stock and bond law, Chapter 593, declares that the power to create liens on public-utility properties is a special privilege with right of regulation by the State. It defines purposes for which all bond and stock issues shall be made and requires stock to be issued only for money, labor or property at its true money value as appraised by the commission. No issue may be made without authority of the commission. The manner of sale of bonds and notes is also prescribed. Chapter 532 modifies the earlier provision that every stockholder of a corporation is entitled to a vote for each share of stock, permitting cumulative voting to assure minority representation among the directors. The Wisconsin Supreme Court has left undetermined the validity of that section of the income-tax law providing for the taxation of incomes of non-residents derived from resources in the State, as well as taxation of interstate business, etc. Chapter 274 gives the common council or trustees of any city or village authority to change the license fees imposed for operating interurban lines through the city limits, provided the license fee is not changed oftener than once in five years. Chapter 611 provides that the property rights, franchises and real estate used in utility businesses are taxable as personal property as a single item. Chapter 612 applies to auxiliary light, heat and power services operated by street-railway companies in connection with their own businesses, taxing these as a unit with the railway and at the State rate. Little legislation was enacted relating to public-utility service in 1911, since such complaints can be remedied by the railroad commission. In one case, however, the Legislature, in order to grant relief, has considered itself wiser than the commission of its creation and has legislated generally for all conditions. Chapter 123 provides that in case of accident no statement signed by the injured party within seventy-two hours of the time of injury shall be used as evidence against him. Chapter 480 provides that no settlement or adjustment of an injury case shall after the case has been brought to court be made without the approval of the attorney for the plaintiff. Chapter 469 requires that all employers of four or more

persons shall keep a record of all accidents causing death or injury.

The most important act from the employees' standpoint passed by the 1911 Legislature was the workmen's compensation act and the creation of an industrial commission. As outlined by the Hon. C. H. Crownhart, chairman of the commission, before the Wisconsin convention, employers who elect to come under this act agree to pay injured employees during the term of their disability 65 per cent of their ordinary wage. In case of total disability this payment is continued six years, and in event of death an equivalent amount is awarded the dependents of the victim. The 65 per cent factor was aimed to prevent malingering or pretense of disability, since the employee suffers a loss of one-third and the employer of two-thirds of the amount of wage. This provision will also make for the use of greater care and safe working conditions on the part of both. In addition the employer is required to pay "first aid" medical services during ninety days following the injury, insuring proper medical attention. Employers who refuse to come under the terms of the new law suffer in case of suit the removal from their defences of the pleas of fellow servant and assumed risk.

Proposed Indiana Public Utilities Commission.

A public utilities law is being considered in Indiana. Governor Marshall of that State says that study of the public utilities laws in those states where most progress has been made has convinced him that instead of creating a separate commission to have supervision of public utilities Indiana should enlarge the powers of its Railroad Commission to include such supervision. Governor Marshall said that work formerly done by the commissioners or left undone is now referred to expert employees. With a law properly enacted, giving the commission increased power, and with the employment of experts to go into the questions involved in public utility control, there is no reason why the Railroad Commission could not attend to the administration of the law at less expense than a separate utilities commission.

PUBLIC SERVICE COMMISSION NEWS.

NEW YORK COMMISSION.

The Public Service Commission, Second District, has closed upon its records the complaint of the president and trustees of the village of Lowell against the Black River Telephone Company as to telephone rates in that village. As a result of negotiations conducted by the commission a satisfactory schedule of rates has been put into effect.

Hearings were continued before Commissioner Maltbie of the First District on Jan. 29, upon the complaint of certain organizations of stationary engineers in New York City that discriminatory rates are given by the New York Edison Company to large users of energy. Counsel for the complainants resumed his questioning of the auditor of the central-station company upon the policy of the company as regards conjunctional service, asking whether the witness would approve contracts for service in several hypothetical cases. After objection of counsel for the Edison company to these questions on the ground that they were not matters of fact was overruled, the witness stated his inability to pass judgment upon any contract until he had seen it, and throughout his examination was unable to give any information concerning the company's methods and affairs not already a matter of public knowledge. The general inspector and general contract agent of the company was called and was asked to define the attitude of the company toward break-down service, and to explain whether a contract with the owner of a private plant who might wish to charge storage batteries from the mains of the central-station company, in order to help the plant on peak load, would come within the break-down classification. This question was answered in the affirmative. The hearing was adjourned until Feb. 1.

NEW JERSEY COMMISSION.

The Board of Public Utility Commissioners of New Jersey has filed a memorandum defining its position with respect to a minimum charge for electric-lighting service. The board has given consideration to the following allegations contained in complaints received by it:

(1) That a minimum charge is unnecessary and unreasonable and should not be made; (2) that, if imposed at all, it should be made by the year and not by the month; (3) that it should not be made when the service is not needed, as when a residence is closed temporarily during the summer months. The third point at issue applies to service furnished at seashore or other summer resorts where dwellings are closed for from six to eight months in the year.

The conclusions of the board are that the exaction of a minimum charge is a reasonable regulation for an electric-lighting company to make; that the making of this charge by the month is just and reasonable and is really more equitable than if the charge were made by the year; that a charge of $1 per month "per plant or installation" is just and reasonable, but that a charge of $1 per meter is excessive where more than one meter is installed. A minimum charge of 50 cents per meter per month is not considered excessive or unreasonable for each additional meter installed on the same premises for the same customer, supplied through the same service. Where a customer requests that service be discontinued for a period of at least one month or more the minimum charge should be waived during such period. Where a customer requires service for a limited period only a reasonable charge may be made for the work of connecting and discontinuing the service at the beginning and the end of the short period. Rules and regulations concerning service and all information in regard to rates and rate schedules should be available to the present or prospective customer. The minimum charge is regarded as part of the rate schedule and should be incorporated with such schedule whenever it is compiled for examination by the public.

Accompanying this memorandum is another filed by the board dealing with the minimum charge for electric energy. The board does not regard a minimum charge of 50 cents per horse-power per month as excessive or unreasonable, and further determines that a minimum charge for electric power service of $1 per month is likewise not excessive or unreasonable.

These conclusions are announced by the board as defining its position in general. In special cases where peculiar local conditions exist the board's position would be modified to suit such cases, upon reasonable ground for such modification being shown.

A hearing has been held on a complaint against the Cinnaminson Electric Light Company in regard to alleged failure to supply service in Riverton. This hearing was adjourned for two weeks with the understanding that an attempt would be made by the company to secure permission to erect the necessary poles and wires to supply service in the district in which the complainant lives.

On Jan. 30 the board called a hearing on the complaint of the Board of Commissioners of Raritan against the Public Service Electric Company. The complainant alleges that the Public Service Electric Company is supplying lighting service to the town of Raritan; that the contract under which such service was heretofore supplied expired on Sept. 1; that the company refuses to renew the contract

upon the terms and conditions of the old contract, but insists upon an increased rate. The Public Service Electric Company admits the above statements, but claims that the terms upon which it offers to renew its contract are in accordance with standard rates for service of similar kind, that such rates are not higher than those made to other municipalities for the same type of service, and that the rates are reasonable.

WISCONSIN COMMISSION.

During the month of November the Kenosha Gas & Electric Company filed with the commission an amendment to its rate schedule for commercial electric lighting in the city of Kenosha which provided for rates considerably lower than those previously in effect. The Kenosha Electric Railway Company, a competing electric utility of Kenosha, subsequently filed a petition praying that reasonable minimum rates and charges for commercial electric lighting and power service in Kenosha be established, and that the Kenosha Gas & Electric Company be forbidden to furnish any service at the rates provided for by its amendatory schedule. The petitioner alleged that the new rates of the respondent were insufficient and unreasonable and that the reduction was made for the sole purpose of commencing a rate war against the petitioner and injuring its business by depriving it of customers. From the hearing and from subsequent investigations it was apparent to the commission that the reasons for the reductions were to be found in those motives which usually actuate such companies when they enter upon rate wars. The respondent's original net rates ranged from 11.4 cents per kw-hour for the first 50 kw-hours used per month to 5.7 cents for the fourth 100 kw-hours per month, with a rate of 3.8 cents for all over 600 kw-hours per month. The amended rate schedule provided for a rate of 5.7 cents for the first 400 kw-hours per month and a rate of 2.97 cents for all in excess of this amount. This schedule is considerably lower than the schedule of rates charged for like service by the petitioner.

From an analysis of the respondent's operating expenses for the year ended June 30, 1911, it appeared that the average cost per kw-hour of the commercial lighting energy sold during the year, including no allowance for interest on the investment and an insufficient depreciation charge, amounted to about 6 cents, or to a somewhat greater figure than the company would receive under its new rate schedule. The actual costs, excluding interest, as determined by the commission, varied from 10.73 cents per kw-hour for the first hour of daily use to 3.86 cents for ten hours' daily use. The commission held that the new rates are not only so low as hardly to cover operating expenses, but are so made up as to be discriminatory as between long and short-hour users; that business and public interests demand that the rates complained of be temporarily altered by being raised to a somewhat higher level and there maintained until the investigation as to reasonable electric rates in Kenosha now pending before the commission has been completed. The respondent was ordered to discontinue its amended schedule of rates and either to reinstate the former schedule or to substitute therefor the rates temporarily provided by the commission, which rates are substantially the same as the ones which are now being charged by the petitioner.

OHIO COMMISSION.

The application of the Cleveland Electric Illuminating Company for permission to issue $1,500,000 stock, to be sold at par, and $1,500,000 bonds, to be sold at 97½, has been granted. This company is contemplating extensions to its new plant and transmission system, as well as other improvements, and the proceeds of the sale of these securities will be used for that purpose. The city administration of Cleveland asked for a formal hearing before the commission before authority was granted to issue the securities, but the officials failed to appear and enter objections. It is believed they intended to fight the issue because of the effect that further enlargements and improvements might have upon the municipal plants.

MARYLAND COMMISSION.

General Counsel William Cabell Bruce has advised the commission to grant a hearing upon the complaint of the Baltimore Electrical Supply Company against the Consolidated Gas, Electric Light & Power Company regarding the wiring of houses and the sale of electrical appliances by the latter. The Baltimore Electrical Supply Company has requested the commission to grant it a hearing with counsel to determine if the electric company has the right under its charter to engage in the business mentioned, saying that the company is doing work at figures with which the independents are unable to compete. Subsequently other electrical companies indorsed the stand taken by the Baltimore Electrical Supply Company.

The Consolidated Gas, Electric Light & Power Company last week sought permission from the commission to rearrange the application of funds raised on bond and common-stock issues amounting to more than $2,000,000 during 1910. At the time of the issuance of the stock and bonds the company declared that it desired to invest $735,000 of a $1,500,000 common-stock issue for the redemption of prior-lien preferred stock and $765,000 for the extension and improvement of its plants and the purchase of additional property. Two bond issues of $844,000 and $60,000 each were also to be used in the improvement of the company's physical facilities. In the new application of the funds the corporation declares that the money will be invested in the improvement of its properties, but desires to reapportion the amounts expended on various parts of its system.

Current News and Notes.

New England Section, I. E. S.—At the January meeting of the New England Section of the Illuminating Engineering Society the general subject for discussion was the artificial production of daylight. Papers on the subject by Messrs. C. H. Sharp, P. S. Millar, H. E Ives and R. B. Hussey were read and discussed. Among those who took part in the discussion were Prof. H. E. Clifford, Mr. V. R. Lansingh, Dr. A. E. Kennelly, Prof. W. E. Wickenden and Dr. Louis Bell.

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Michigan Association Convention Cruise.—The Michigan Electric Association, which has become affiliated with the National Electric Light Association as the Michigan Section, will hold another convention cruise this year, leaving Port Huron, Friday, June 21, for a sail through Lake Huron and Georgian Bay on the Northern Navigation Company's steamship *Majestic*. The first stop will be at Pentang, on Georgian Bay, from which point a smaller vessel will convey the party through the Thirty Thousand Islands. At Parry Sound on Saturday evening, when the big boat will be rejoined, a dance will be held at the hotel, and on Sunday morning a daylight cruise will be made from Killarney through St. Mary's River to the "Soo." Mackinac Island will also be visited, the return trip ending at Port Huron Tuesday afternoon. All sessions and convention proceedings will be held on board the boat. More than 100 electrical men and their wives enjoyed the 1911 cruise of the Michigan Association through Lake Michigan to the "Soo," and a larger attendance is expected this year. Mr. Herbert Silvester, 18 Washington Boulevard, Detroit, is secretary of the Michigan Section.

MEETING OF NATIONAL ELECTRICAL SUPPLY JOBBERS' ASSOCIATION.—The annual meeting of the National Electrical Supply Jobbers' Association will be held at the Hollenden House, Cleveland, Ohio, Feb. 13-15.

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SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION.—The eighth annual convention of the Southwestern Electrical and Gas Association will be held at San Antonio, Tex., on April 25-27. Mr. David G. Fisher, 3419 Hall Street, Dallas, is secretary.

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SOUTHERN SONS OF JOVE.—The "rejuvenation" of the Sons of Jove in Raleigh, N. C., of which note was recently made in these columns, will be held on Saturday evening, Feb. 17, and the indications are that the attendance will be large. Mr. N. L. Walker, of Raleigh, is statesman for North Carolina.

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MILLION SUBWAY PASSENGERS DAILY.—For the first time since the New York subway was built the average traffic for an entire month was more than 1,000,000 persons daily during December. The tickets sold for twenty-eight days aggregated 28,495,555. The subway traffic exceeded the combined traffic on all four elevated lines in Manhattan and the Bronx by more than 1,600,000, the total for the four elevated lines being 26,887,240.

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POWER COSTS.—At a meeting of the American Institute of Electrical Engineers on Friday evening, Feb. 9, a paper entitled "A Method of Studying Power Costs with Reference to Load Curve and Overload Economies" will be presented by Mr. G. I. Rhodes, of the Interborough Rapid Transit Company. The technical meeting will adjourn at 10 p. m., after which a smoker will be held in the Institute offices on the tenth floor of the building.

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POSTAL TELEGRAPH COMPANY CO-OPERATING WITH INDEPENDENT TELEPHONE SERVICE IN CHICAGO.—The Illinois Tunnel Company, which operates the competing automatic telephone service in Chicago, announces an arrangement with the Postal Telegraph-Cab'e Company by which the automatic service may be used to telephone to Postal receiving offices messages to be sent by telegraph. A monthly account will be rendered to "automatic" subscribers for telegraph messages received in this manner.

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A. I. E. E.-UNIVERSITY OF ILLINOIS SMOKER.—On Jan 19 the Urbana Section of the American Institute of Electrical Engineers and the Electrical Engineering Society of the University of Illinois held a joint smoker at which more than 200 engineers and students were present. After the regular schedule of refreshments and several vaudeville features, President R. S. Leese of the society introduced Dr. E. J. Berg, of the University of Illinois, and Prof. Morgan Brooks, vice-president of the Institute, who gave short talks. The smoker was highly commended by several out-of-town guests, and a motion to make it an annual affair was agreed to by both societies.

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SONS OF JOVE AT PEORIA.—On Jan. 26 during the Peoria Electrical Show there was held a "rejuvenation" of the Sons of Jove under the direction of Statesman Henry N. Remington. Twenty-five candidates were taken into the light of a better understanding of the principles of electrical fraternalism. A regular lodge hall was used for the initiation ceremonies, which were followed by a dinner. Mr. A. A. Gray was the toastmaster, and Messrs. Boole, Loring and Kearns told why they belonged to the order. At the conclusion Mr. Remington received three cheers for conducting a rejuvenation that was a credit not only to the order but also to himself. The degree team was made up as follows: Jupiter, Mr. F. R. Farmer; Neptune, Mr. A. A. Gray; Pluto, Mr. P. R. Boole; Vulcan, Mr. J. W. Foster; Mercury, Mr. A. J. Selzer; Hercules, Mr. J. S. Jacobson; Mars, Mr. E. W. Kearns; Apollo, Mr. V. R. Despard; Avrenim, Mr. C. W. Furtney; imps, Messrs. W. E. Bischoff and R. W. Everson.

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ST. LOUIS N. E. L. A. SECTION.—At the January meeting of the St. Louis Section, National Electric Light Association, Jan. 26, Mr. R. H. Nicholson presented an illustrated paper describing the construction of the Union Electric Light & Power Company's Ashley Street generating station. Special attention was directed to the building of the river wall, which was finally completed by the Union company engineers after two contractors had failed. "Conditions Encountered in the Sale of Electric Power to Isolated Plants" was the subject of a paper by Mr. William Rose before the Dec. 27 meeting of the section. Among some interesting actual cost figures of isolated-plant operation Mr. Rose pointed out an instance where a steam-flow meter test showed that a 35-hp engine could be replaced by a 3-hp electric motor.

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BRITISH CENTRAL-STATION PUBLICITY PERIODICAL.—The Electric Supply Publicity Committee, which represents the principal central stations of Great Britain, commenced on Dec. 1 the publication of a monthly periodical called *The Journal of the Electric Supply Publicity Committee.* The object of the committee, which was organized about two years ago, is to advance the sale of electricity, and to this end it has issued up to the present about 100 circulars, booklets, etc., for distribution by central stations. It has also done work through newspapers, both in an educational way and by advertising. That the work of the body has been effective is evident from the fact that to counteract its influence the British Commercial Gas Association has been organized and proposes to expend $125,000 annually in maintaining the gas interest against the inroads of electricity.

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MILWAUKEE SECTION. N. E. L. A.—At the monthly meeting of the Milwaukee Company Section, N. E. L. A., Jan. 25, Mr. Egbert Douglas, sales manager, presiding, a paper was read on "The Electric Vehicle as a Source of Revenue to the Central Station," by Mr. Godfrey H. Atkin, manager of the Chicago office of the Electric Storage Battery Company. Mr. Atkin pointed out the growing use of electric-pleasure vehicles and trucks, adding that central stations had not shown the interest this off-peak load warrants. The paper was followed with a talk by Mr. E. W. Goedjen, of the Comonwealth Edison Company, Chicago. During the meeting it was announced that The Milwaukee Electric Railway & Light Company, as agent for the Rauch & Lang Carriage Company, would actively push this branch of its business, having already opened a public garage for electric pleasure and commercial vehicles.

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EDISON'S ELECTRICAL HOUSE.—Mr. Thomas A. Edison has developed a type of voltage regulator based on the principle of varying the resistance in the delivery circuit in order to keep the delivered voltage constant independent of load fluctuations and variations in the supply voltage. It is claimed that with the simplest possible isolated-plant generator and storage-battery equipment operated without attention the voltage delivered is maintained within 3 per cent of normal at all loads. A 2-kw gas-engine-driven isolated plant with storage-battery auxiliary is now being installed in an "electrical house" which the inventor is equipping in Orange, N. J. The house will be lighted with forty lamps and provided throughout with domestic electrical devices of all kinds, including laundry machines, heaters, cooking outfits, refrigerators, etc. The whole installation will be placed in active service during the present month.

Date of New England Convention, N. E. L. A.—On account of the Boston Automobile Show, which will be held in the middle of March, the annual meeting and convention of the New England Section of the National Electric Light Association has been postponed from March 14 and 15 to March 21 and 22. The place of meeting, as previously announced, will be the Hotel Kimball, Springfield, Mass.

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Wisconsin Electrical Contractors.—At its convention in Milwaukee, Jan. 17, the Wisconsin Electrical Contractors' Association elected Mr. John L. Acker, of Sheboygan, president; Mr. F. W. Pitman, LaCrosse, vice-president; Mr. George Knoerr, Milwaukee, treasurer, and Mr. Albert Petermann, Milwaukee, secretary. Mr. A. C. Langstedt, of Appleton, was chosen to serve for three years on the board of directors, the holdover members of which are Messrs. G. F. Rohn and F. W. Pitman. The summer meeting of the Wisconsin contractors will be held in August at Waupaca and Chain-of-Lakes, Wis., where a vessel will be chartered for a convention cruise.

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Los Angeles A. I. E. E. Section.—At the regular monthly meeting of the Los Angeles Section of the American Institute of Electrical Engineers on Jan. 23 Mr. E. V. Porter presented a paper entitled "Comments on Show-Window Lighting," and Mr. F. B. Lewis also read a paper on "Practical Illumination." The papers were discussed by Messrs. A. J. Kennedy, F. S. Mills and R. H. Manahan and Profs. R. W. Sorenson and A. W. Nye. Professor Nye dwelt mainly on the eye ("the receiving end," as the speaker put it). A large glass and porcelain eye was shown, assembled and in parts. The effect of colors upon the eye was also explained and illustrated by stereopticon views.

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Dinner of New York Section, I. E. S.—Preceding the meeting of the New York Section of the Illuminating Engineering Society to be held at 8:15 p. m. on Feb. 8 in the Engineering Societies Building an informal dinner will be served at Keene's Chop House, 66 West Thirty-sixth Street, beginning at 6 o'clock. It is hoped that this dinner will be attended by a large number of those who will attend the meeting and that the social element thereby introduced will prove of much benefit to the section. The paper of the evening will be entitled "Choice of Reflector: Its Influence on Illumination Efficiency and Depression of Visual Function," by Messrs. A. J. Sweet and L. C. Doane.

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Fraudulent Metallic-Filament Lamp.—Following a confession of his guilt in open court James B. Grenagle, president of the Grenagle Electric Company, who was convicted in Baltimore of using the mails to defraud in connection with sale of stock for an alleged new invention of a metallic-filament lamp, was sentenced to eighteen months in the federal prison at Atlanta last week by Judge Rose in the United States District Court. Grenagle's confession, coupled with the fact that he is married and has five children, served to lighten his sentence. In his confession he declared that the electric lamps shown by him and declared to be of his invention were none other than tantalum lamps consigned to the New Howard Hotel, where he worked. Grenagle collected about $30,000 in subscriptions to stock in the company organized by himself.

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Central Stations Victimized.—Some central stations in small towns and cities have recently been having a disagreeable experience following the giving of a trial order for, as they supposed, a small quantity of a new metal. The agent explained that his firm was introducing a new metal made abroad, and that there would probably be no charge at all on a small trial order. On the understanding that the total cost of a trial order will not in any event exceed $5 a blank is offered for signature on which quantities are expressed in metric units. In due course a shipment arrives consisting of some hundreds of pounds of metal accompanied by a correspondingly large bill. In the case of one central station the bill was $340, and in another $420. Upon protest from the central station it is informed that the shipment must be accepted and the bill paid.

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St. Louis League of Electrical Interests.—President Sam A. Hobson, of the St. Louis League of Electrical Interests, has appointed the following committees for the ensuing year: Executive committee—Messrs. W. N. Matthews, W. N. Matthews & Brother; W. A. Layman, Wagner Electric Manufacturing Company; F. D. Beardslee, Union Electric Light & Power Company; Fred. B. Adam, Frank Adam Electric Company. Entertainment committee—Messrs. W. E. Rapp, H. W. Johns-Manville Company; Fred Johnson, Wagner Electric Manufacturing Company; Milton Mill, manufacturers' agent; George Corrao, William Corrao Construction Company; Charles M. Biggers, electrical advertising artist. Public affairs committee—Col. E. J. Spencer, C. E.; Messrs. E. J. Pietzcker, Standard Underground Cable Company; Guido Pantaleoni, Westinghouse Electric & Manufacturing Company; George E. Cullinane, Western Electric Company. Mr. Pantaleoni gave an interesting talk at the meeting on Jan. 23, in which he related the manner of the introduction of alternating-current machinery into the United States.

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Philadelphia N. E. L. A. Sections.—The meter branch of the Philadelphia Electric Company Section of the N. E. L. A. met on Jan. 5. Mr. Frederick Strattner, of the Philadelphia Electric Company laboratory, presented a paper on "Wireless Telegraphy," explaining the governing principles of this branch of the electrical science. Messages were sent to and received from local points, messages from Cape Cod were intercepted and communication was established with a steamer at Marcus Hook on the Delaware. The accounting department branch meeting was devoted to a general discussion of department problems. "Opportunity night," as observed by the commercial department branch on Jan. 22, was an interesting occasion. The first speaker, Mr. John E. Dougherty, of the soliciting department, talked on "What the Present Time Means to Us," pointing out the larger responsibilities that devolve on the individual employee in view of the development of the many and varied uses of the company's product and the ever-increasing demand. Mr. A. C. F. Keleher, of the Holophane Company, talked on "Opportunities of Practical Illuminating Engineering," urging his hearers to advance to the higher conceptions by utilizing the opportunities available to all through the various practical educational channels. The general section meeting was held on Jan. 15, and Dr. Edgar Fahs Smith, provost of the University of Pennsylvania, showed "How the Chemist May Use Electric Current." Dr. Smith performed many interesting experiments and surprised those of his audience who were familiar only with the old methods of chemical analysis by demonstrating how the work of qualitative and quantitative analysis formerly requiring hours or days to accomplish may by electrical methods be accomplished in a few minutes. He also gave a practical demonstration of the use of electrical current in the manufacture of the nitrates and in the manufacture of carbide, as well as of metal calcium, showing quantities of calcium that has been produced in the laboratory of the university. Dr. Smith urged the practical electrical men to enter into closer study of the possibilities of the use of electric current in chemical work, and pointed out the vast possibilities of the field as yet almost untouched in this country.

NEW HYDROELECTRIC PLANT OF NORTHERN CALIFORNIA POWER CO.

Coleman Plant Part of a System Delivering Energy at 66,000 and 22,000 Volts Over Nearly 400 Miles of Lines.

Details of Construction of the Dam, Pipe Lines and Power House—Turbines Operating Under 480-Ft. Head Producing 27,000 hp for Mining and Agricultural Purposes.

By RUDOLPH W. VAN NORDEN.

IN the region of the State of California which is overlooked by Mount Lassen the Northern California Power Company operates five hydroelectric generating stations having an aggregate rating of 47,000 hp, feeding energy to 196 miles of 66,000-volt and 258 miles of 22,000-volt transmission lines. Of these plants the first built and the one best known is the "Volta," the generating equipment of which has a total output rating of 8500 hp. This plant operates under a hydraulic head of about 1200 ft. A second plant, operating under an equal hydraulic head, is the "Kilarc," having a present generating equipment rating of 4000 hp, with provision for increasing the equipment to 8000 hp. Two other plants, utilizing lower heads, are the "South," with 6500 hp in equipment, operating under a 500-ft. head, and the "Inskip," with 8000 hp in machinery, using a head of 370 ft.

During the present year the company placed in service its largest plant, known as the "Coleman," which utilizes a head of 480 ft. for driving machinery, having a generating rating of 20,000 hp. The equipment consists of three 5000-kva, 6600-volt generators delivering energy to three 5000-kva, three-phase transformers for raising the emf to 66,000 volts. A fourth three-phase transformer is on hand for reserve.

The Coleman plant makes use of water diverted by a dam across South Battle Creek, a short distance below the Inskip plant. The South plant is 5 miles above Inskip on South Battle Creek. The Volta plant gets its water partly from North Battle Creek and partly from springs. It is situated near North Battle Creek, but its discharge is carried across country to the South power house, a distance of 6 miles.

DETAILS OF THE COLEMAN DAM.

The dam is of rubble-masonry construction, situated in the south fork of Battle Creek, about 200 yd. below the discharge of the Inskip power house. This dam has a height of 15 ft. and the length of crest is about 110 ft. It is straight with a gravity section, and the overflow weir occupies the entire length, having an ogee profile. At the east end of the dam there is a rubble-masonry retaining wall, in direction perpendicular to the line of the dam, which forms the outer wall of the intake canal. This wall extends upstream from the dam about 50 ft. and then curves into the north bank. In it are two openings through which water passes from the pond formed by the dam and which contain screens. This retaining wall extends below the dam for a distance of about 300 ft., where the earth canal commences. At this point are the sluice gates and also waste gates. Both sluice and waste gates are of timber framework and construction and consist of two sliding panels placed abreast in heavy timber frames, the latter being fastened into the masonry walls and abutments. These abutments have a gravity-dam section. The gates are raised and lowered on a steel rack and pinion gear, hand-operated. This method is followed practically throughout the whole of the northern California system and is a typical old-style California construction, dependable and simple. The gates slide on steel rollers, which press against steel plates bolted to the gate face. The canal has a normal section of 11 ft. at the bottom, and the depth of water is 5.5 ft. Beyond siphon No. 2 the canal is 16 ft. wide and the water 6.5 ft. deep. There are places where the cut is as deep as 35 ft. As a rule the sides are nearly vertical. The cut is made entirely in virgin soil. No dependence is made on the spoil bank thrown up on the

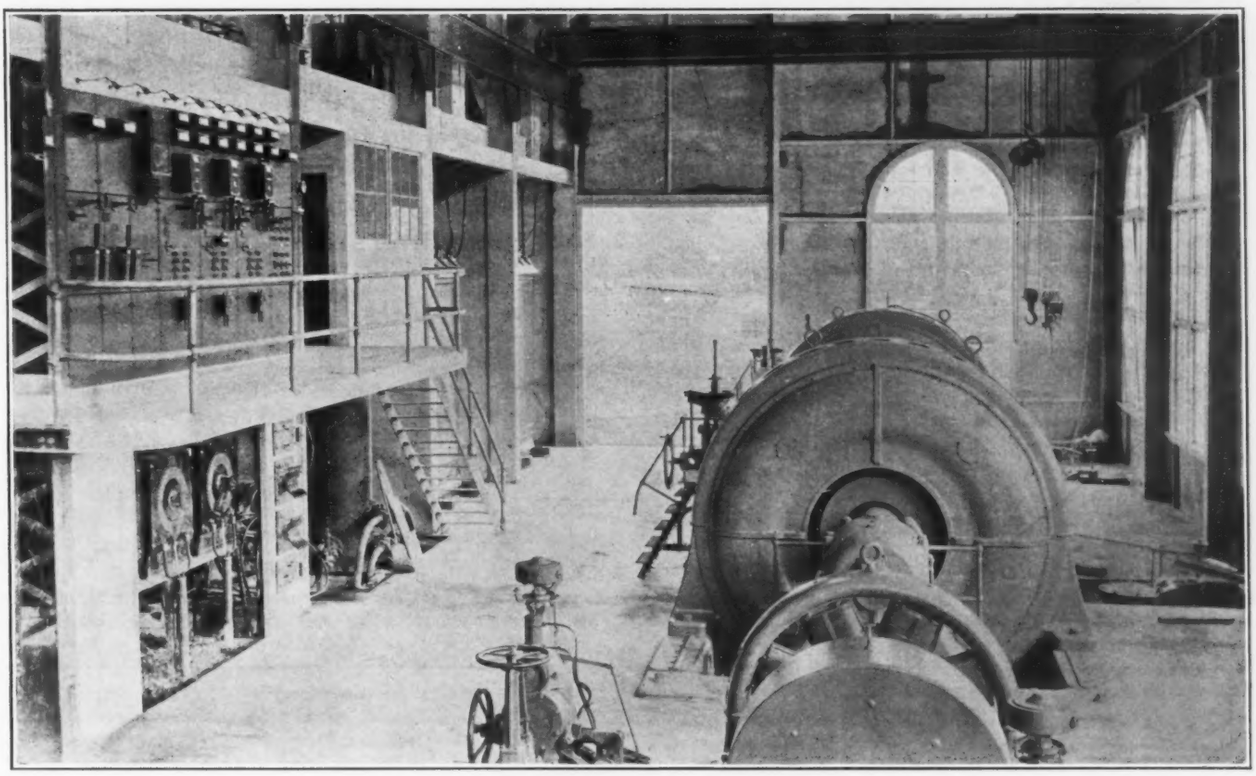


Fig. 1—Interior of Generating Station, Showing Waterwheel Units and Switchboard.

lower side, which, however, is in most cases very large. This again follows good California practice, as ditches which have been built to depend upon the spoil bank in part for the outer wall have been failures. The normal quantity of water for which the ditch is designed is 325

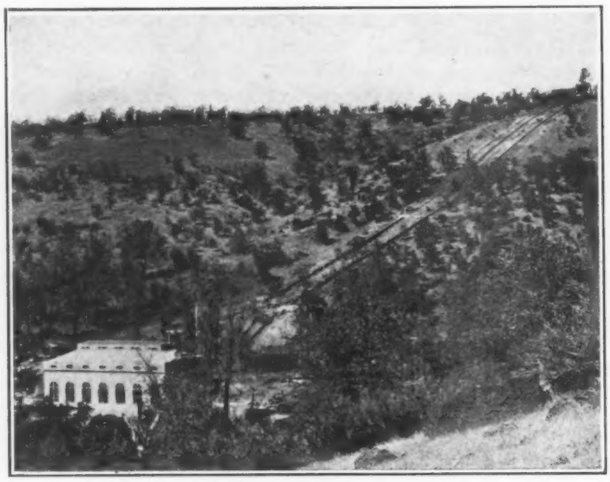


Fig. 2—Penstocks and Power House.

cu. ft. per second to siphon No. 1 and 500 cu. ft. per second from end of siphon No. 2 to the Forebay. The ditch has been constructed throughout with the use of four steam shovels. This mode of construction makes the cost of canal excavation about one-third that of hand and team work.

After the shovels had finished their work the cut was cleaned and smoothed up with the use of movable derricks, which operated skips loaded by hand. Use was made of eight derricks, operated either by electric motor hoist or by an air hoist, and each requiring a crew of about fourteen men. Camps were built at several places along the line, and at four of these points were air compressor plants. The compressors were driven by induction motors, which supplied air not only to the drills but also to the steam shovels. Fuel is expensive here, because it must be hauled for from 12 to 25 miles over the mountain roads. Electric energy furnished from the Inskip plant cost practically nothing.

In the various compressor plants there were eleven compressors, varying in rating from 220 cu. ft. to 880 cu. ft. of air per minute. Those were driven by induction motors of from 50-hp to 200-hp rating. A 6600-volt transmission line was constructed early in the work from the Inskip power house to the Coleman site, and this line was tapped wherever necessary. It has been so built that it will be used as a main transmission line to operate at 66,000 volts.

The canal has a total length of 10.5 miles. There is one tunnel just below the intake dam, which is 367 ft. long. It has a section of about 12 ft. by 9 ft. and is unlined. The canal contains two inverted siphons. The first is at the crossing of North Battle Creek. It is a riveted steel pipe 1270 ft. long. The inside diameter is 76 in. and the steel has a thickness of 0.25 in. The greatest head on the pipe is 80 ft. At the crossing of the creek the siphon is carried on masonry piers, the central span being a steel Howe-truss bridge 50 ft. long. Between the first siphon and the second there is a length of canal of 1000 ft. The second siphon has a length of 3557 ft. The greatest head is 115 ft. and the friction head 7 ft. It consists for the first 1815 ft. of a reinforced-concrete pipe on which the maximum head is 46 ft. The inside diameter is 87 in., thickness of concrete at the bottom 7 in. and on top 5 in. It is reinforced with triangle mesh, the weight varying with the head, having a factor of safety of two without reference to strength of concrete. There is, in addition, a longitudinal strip of reinforcement on the top and bottom. This pipe was made in wooden forms which were built on the ground. The remainder of this siphon is of steel riveted pipe 86 in. inside diameter, thickness 0.25 in. Between the concrete and the steel is an expansion joint surrounded by a block of reinforced concrete. Along the canal are nine masonry waste weirs; six of these are placed where the canal crosses a gulch and have sand boxes equipped with a double submerged sluice gate, 30 in. by 30 in.

Water from North Battle Creek is diverted by a small masonry dam and is carried in a ditch to Darrah Creek. This ditch is 2 miles long. Darrah Creek joins Baldwin Creek and the flow is diverted by a small masonry dam from Baldwin Creek into a metal flume. This flume has a semi-circular section 10 ft. in diameter and carries the water into the main canal at a point at the outlet of siphon No. 2. There is no lining at any point of the canal, as it is found that this material holds water well and that the walls stand up. However, considerable dry rock-wall riprap has been built.

The forebay was made by throwing up two wing walls of earth. These converge from the penstock. The penstock consists of rubble-masonry walls. It is 50 ft. across at end, and in the middle has a constricted section in which are placed sluice gates and fine screens. An inclined "grizzly" of 0.25-in. by 1.5-in. iron bars spaced 2 in. apart is built in the canal before it terminates.

THE PIPE LINES.

There are two pipe lines parallel to each other. They are inserted through the wall of the penstock, the ends of

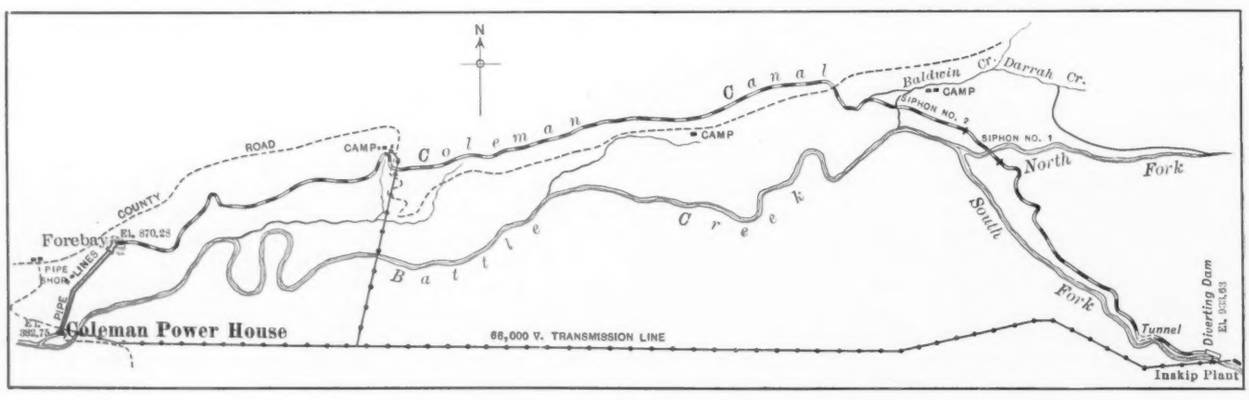


Fig. 3—Map of the Coleman System.

the pipe being enlarged by a tapering section, and are elliptical. The diameter of the pipes at the inlet is 72 in. and the thickness is 0.25 in. The pipes are not buried but left on the ground surface. They are anchored at a number of points into blocks of concrete around which are piled sev-

eral tons of loose boulders. The pipe is ballasted with boulders. The pipes follow the natural grade almost to the power house, when each enters a tunnel. This arrangement was necessary in order to get below an abrupt hump in the grade line. The east tunnel is about 100 ft. long, the west about 400 ft. The diameter of the pipes at the bottom is 00 in. and the thickness is 9/16 in. The thickness of the 48-in. pipe leading from the gate valve is 0.5 in.

Saddles are placed on the pipes before they emerge from the tunnels; a branch is taken from each approaching the others. Directly in the rear of the power house are four 48-in. hydraulic piston-operated gate valves, one in each main pipe and one in each branch. After passing the two latter the branches join in a cast-steel "Y." From the two mains and the "Y" are led the three penstocks to the waterwheels. A 12-in. exciter connection is taken from each branch. These also join, are carried below the main power-house floor and then separate to feed the two exciter units. The hydrostatic head is 487.53 ft. Each pipe line is 3600 ft. long.

POWER HOUSE.

This system is unique in many respects, for, while it does not have some of the difficulties of climate to contend with that many large Eastern networks have, there are many conditions peculiar to the system. On the whole, it is a typical Pacific Coast—or, more correctly, California—production.

Ten years ago the area now served was scantily populated, there being almost no enterprise and little prospect. Great copper mines were developed and later iron mines came into existence, largely through the possibility of getting cheap energy. The farmers in the southern section were taught that they could pump cheaply and thus irrigate vast areas of practically dead land to raise alfalfa. A contract to supply energy at wholesale was made with the Pacific Gas & Electric Corporation. Thus, almost before it could be realized, the earlier plants were loaded and it was difficult to keep abreast of the demand. The service requirements are very severe, especially in view of the fact that many of the transmission lines traverse country which is extremely difficult to follow, but the load factor on the system is very high; in fact, at times it is practically unity.

The foregoing explanation is made to illustrate the necessity of understanding thoroughly the requirements of the system, not only as regarded the proper design of the new plant but also as necessitating the utmost economy both in construction and operation and at the same time reducing operation to the simplest and safest point.

With the exception of the automatic governing of the waterwheels the system is entirely hand-operated; notwithstanding criticism to the contrary from Eastern operators, this method seems to be preferable in such systems.

In the design of the Coleman power house the operator at the switchboard has complete control and if necessary can operate the plant without further assistance. His position is raised sufficiently above the main station floor so that he may see and in fact speak to his assistant wherever he may be on the floor. Being at the center of the building, he is himself at a minimum distance from any governor or other machine. The high-tension switching gallery is directly at the rear, separated by fireproof barriers, and can be reached in a few steps. The high-tension oil circuit-breakers and disconnecting switches are so arranged as to permit of the least confusion, and their position or condition may be seen at a glance. The transformer switches are placed directly behind their respective transformers. All of these being on the front side of the high-tension room, the disconnectors are directly in line. The outgoing switches are on the opposite side and directly under the outgoing lines. The leads from the generators are 600,000-circ. mil oiled-muslin-insulated copper cable and are carried through 3-in. fiber tubes, placed in the concrete floor and walls, directly to their respective transformers, after passing through two sets of oil circuit-breakers and the accompanying disconnecting switches. The circuit-breakers are placed on a floor directly above the respective transformers. In each set is a third set of disconnecting switches which connect to an equalizing bus and through which the spare transformer receives energy.

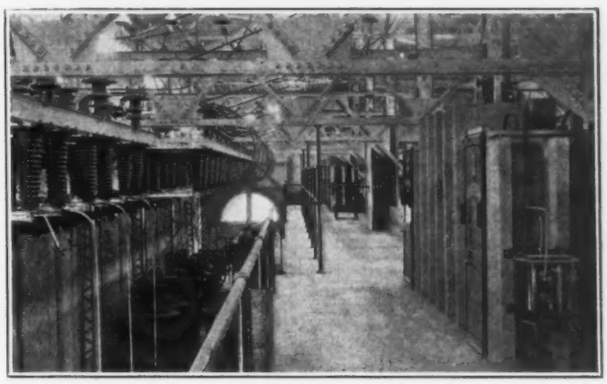


Fig. 7—Switch Cells, Instrument Transformers and High-Tension Lines Within the Building.

There are three main generating units rated at 5000-kva, 450 r.p.m., three-phase, 60 cycles and 6600 volts. Sheet-steel turbine fans on both sides of the rotor draw air through the stationary armature laminations and discharge it in both directions parallel to the shaft. The waterwheels are of the Allis-Chalmers-Francis type, equipped with relief valve and oil-operated governor. There are two 225-kw, 120-volt exciters driven by overhung tangential waterwheels in cast-iron housing, with needle regulating nozzle, governor and hand gate-valve. These units are so arranged that the floor operator may stand close enough to manipulate either or both governors with only a slight change of position. The station lamps and the governor oil pumps, operated by 50 hp direct-current motors, receive energy from the exciters.

In the space under the switchboard (a plant by itself) are the following auxiliaries: Two gear oil pumps and motors using Morse chain drive; generator rheostats; com-

Figs. 4, 5 and 6—Typical Scenes Along Canal, Flume and Pipe Lines.

pressor driven by a 20-hp induction motor, to supply compressed air for moving the transformer oil from the storage tanks and for driving the tools in the power house or near by on the outside, and a transformer oil filter and purifier. The air pipes are provided with outlets at all convenient points in the power house and are also carried outside. A tunnel runs the entire length of the building below the main floor, 12 ft. wide, 8 ft. in clear. In this all piping is arranged for ready inspection. There are also two large transformer oil tanks and a governor oil tank in the tunnel.

The transformer oil tanks are 6 ft. in diameter and 16 ft. long, and will hold the oil necessary to fill one transformer. New oil is poured through the manholes in both the floor and the tanks from the barrels or tank wagon. Through a system of pipes it may be delivered to any transformer, air pressure being used to force the oil. Oil may be run from the transformers into the tanks or from one tank through the filter into the other. This oil may also be circulated by a motor-driven gear pump on the filter. There are four transformers, one of which is a reserve unit. They are three-phase units designed for 6600-volt primary to 66,000-volt star-connected secondary. They are mounted on four-wheeled structural-steel trucks and stand 8 in. above the

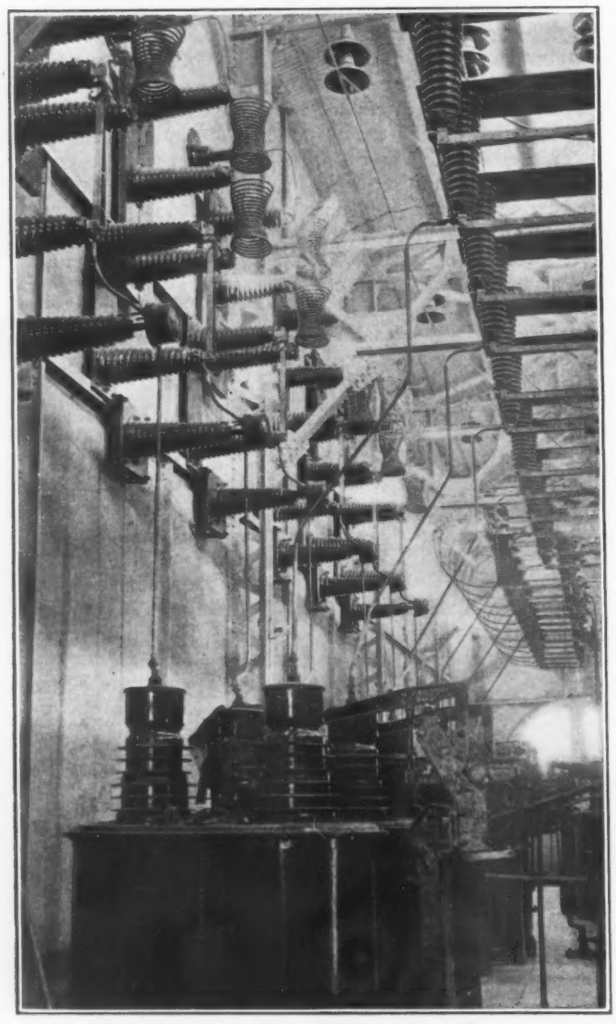


Fig. 8—Circuit-Breakers, Choke Coils and Wall Insulators.

floor. They are in fireproof cells, but may be moved out into the main bay. The 30-ton hand-operated traveling cranes having a span of 34 ft. operate the length of the main bay. The switchboard is placed in the center of the building 10 ft. above the main floor. The gallery is reached by two steel stairways. On one side are a telephone booth and the foreman's office. On the other is a lavatory. The switchboard has seven black-slate panels. Nos. 1 and 2 are for exciters; No. 3 is for a Tirrill regulator; Nos. 4, 5 and 6 are for the main generators, and No. 7 is for the trip control of the outgoing lines and the transformer circuit-breakers. An eighth panel is provided for twelve local

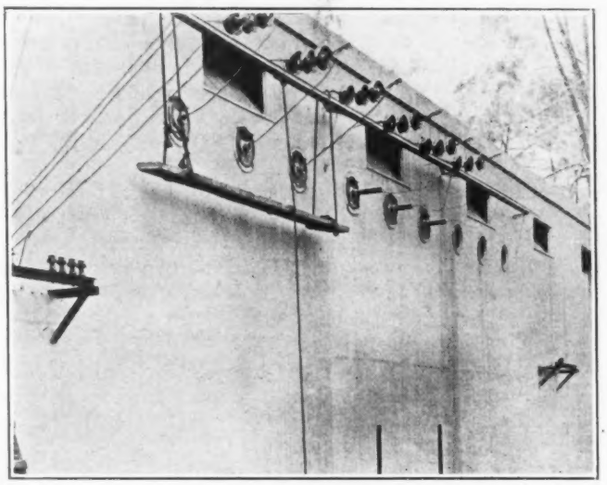


Fig. 9—Outgoing Transmission Lines.

lighting circuits and reservoir signals. High-tension circuit-breakers are hand-set and electrically tripped from switchboard. The 6600-volt generator and transformer circuit-breaker are of the solenoid-operated type controlled by push-buttons on the switchboard. The three outgoing lines are provided with ground detector ammeters mounted on post insulators, and also with double-cone choke coils. Outside of the building each line is equipped with aluminum cell lightning arresters. The arresters are placed in a steel and concrete building a short distance east of the power house.

The structural-steel frame of the building has been designed to withstand all strains without the aid of walls. The walls are formed of a 2-in. layer of cement plaster on "Hyrib" expanded metal. The roof is of corrugated galvanized iron. The cornices and gutters are reinforced concrete. The foundations are very heavy and are reinforced thoroughly with 12-lb. railroad iron, the machine foundations resting on a mattress of reinforced concrete.

There are two high-tension bus lines and therefore two sets of disconnecting switches from each of the oil circuit-breakers. All wiring is concealed in galvaduct placed in the concrete floors. The high-tension wiring is of 0.75-in. copper tubing throughout. The disconnecting switches are so arranged that the bar is horizontal. In order to prevent the possibility of falling out, use is made of a simple latch designed by the writer, which latches automatically when the switch is closed and is opened automatically when the hook is properly inserted in the eye on the switch-bar.

All high-tension lines pass through the walls in specially designed Locke insulators. The insulator is 18 in. in diameter and through it is inserted a 3-in. porcelain tube 36 in. long. The insulator is mounted in a circular sheet-metal ring, the later being cut from common No. 24 galvanized iron. The ring is permanently fastened into the wall, the hole in the wall being about 1 in. smaller in diameter. Thus there is formed a flange against which the insulator petticoat rests. After the insulator is inserted a ring of 0.5-in. round iron holds the insulator in place, it in turn being held by four bolts with clamps permanently fastened in the wall. The insulator is securely held against any strain, but it can be removed by merely loosening the nuts on the four bolts. Like the lock for the disconnecting switches, the device has the additional advantage of being very cheap to construct.

Only two of the three high-tension lines will be used at present, one taking a northerly direction and joining with the line which now runs to the smelter district. The other will run southeast and tap into the Volta-Chico line.

In the tunnel, already mentioned, besides the main penstock, which crosses the tunnel, the transformer oil-piping system and the governor pressure piping system, which carries oil from the pumps to the various governors, there were four water-piping systems. One set of piping takes water from the exciter pipe, which, after passing through reducing valves, supplies the necessary water for cooling the transformers and also for all other uses in and about the power house. The second system takes water from the main pipe lines for the purpose of supplying the draft tubes with water before starting up. The third set of pipes supplies water for cooling the main generator bearing. The fourth set of pipes comes in from both of the main pipe lines, starting from points back of the main gates, for the purpose of supplying operating pressure to the relief valves on the large waterwheels.

The compressed-air pipes are also carried through the tunnel. In all cases these various systems of piping are arranged so that inspection can be had at all times and every part easily got at for repair.

All of the pole structures erected near the power house for supporting the high-tension lines are of reinforced concrete. They vary in length from 30 ft. to 50 ft. They are square, 8 in. at the top, and the longest poles 14 in. at the bottom. They are reinforced with round steel rods and were built at the point of erection.

Below the power house in the distributing canal is an Anderson measuring flume 100 ft. long. This was built for the purpose of making accurate tests of the waterwheels and pipe lines.

The president of the Northern California Power Company is Mr. H. H. Noble, who was chiefly instrumental in the earliest developments and has directed all later enlargements. The secretary is Mr. Edward Whaley, who assumed charge of construction work on the Coleman canal. The Coleman power-house construction was in charge of Mr. Perry O. Crawford. The writer has acted as consulting engineer for the company.

ELECTRICALLY HEATED GARMENTS FOR OUTDOOR WORKERS.

Practically all astronomical observing work must be done in rooms or observatories at the temperature of the outside air to avoid optical and instrumental difficulties. The discomforts of a long winter-night's vigil at the eyepiece of a big telescope are readily appreciable, and many special constructions of instrument mountings have been devised to allow the observer to remain in a heated compartment. Most of those constructed gain the advantage of comfort at the serious cost of light lost in reflecting surfaces and mirrors. A novel "turret-type" mounting described by Mr. James Hartness, of Springfield, Vt., before the American Society of Mechanical Engineers at New York, Dec. 6, modifies the polar-axis shaft into a turret casting 7 ft. in diameter and weighing 2 tons, inside of which the observer may remain comfortable. The great weight and wind resistance of such a huge mass to be driven accurately by clockwork in siderial time, as compared with the usual equatorial mounting, led Prof. F. R. Hutton to suggest in discussion the use of electrically warmed garments for observers having the ordinary telescopic mountings. Such garments, he said, might be made but little larger than the body, so as not to be cumbersome, and need only supply the equivalent radiation losses at the bodily rate. The observer could then use in entire comfort the present simple and efficient mountings.

THE MANUFACTURE OF ARTIFICIAL ICE AS A CENTRAL-STATION BY-PRODUCT.

Description of Ice-Making Processes That May Be Used in Connection with Electric Central-Station Operation.

BY SYDNEY F. WALKER.

THE tendency to increase the profits of an electric generating station by either adding an ice-making plant or supplying power for cold storage and ice making is steadily increasing, particularly in America, where such advances are usually made much earlier and much more rapidly than in the old countries. The addition of an ice-making plant to an electric generating station is perfectly legitimate business, provided that what follows is carefully understood and carried out.

In the first place, it must be clearly understood that, as pointed out in a previous article, the machine designed to perform what is called a ton of refrigeration will not make a ton of ice. The ton of refrigeration, as mentioned in that article, is the cooling effect produced by the melting of a ton of ice in twenty-four hours. The American ton of ice being 2000 lb., and the latent heat of water—that is, the heat that must be abstracted from every pound of pure water at 32 deg. Fahr. to convert it into ice at the same temperature—being 142 lb.-Fahr. thermal units, it follows that the American ton of refrigeration is 284,000 units in twenty-four hours, or 11,700 units in one hour, or 1950 units in one minute. Machines sold as able to do 1 ton of refrigeration are designed, when driven by the necessary power and when their condensers are furnished with cooling water not above a certain temperature, to extract heat from a cold store or an ice-making tank at that rate. The British ton of refrigeration is slightly higher, the British avoirdupois ton weighing 2240 lb. A 2-ton machine will extract heat at twice the rate given above per minute or per hour; a 3-ton machine at three times the rate, and so on. But it is the usual rule to look upon a machine that will furnish 1 ton of refrigeration as being equal to the production of ½ ton of ice; upon a 2-ton machine as being capable of furnishing 1 ton of ice, and so on. The reason for this, as pointed out in the previous article, is that the cooling effect produced by the melting of 1 ton of ice is quite different from the quantity of heat required to produce 1 ton of ice from water. Water at the ordinary temperature in America would be at about 70 deg. Fahr.; and therefore every pound of water has to be lowered through 38 deg. Fahr. before it reaches freezing point, or 38 lb.-Fahr. thermal units have to be abstracted from it. In addition, in order that the ice may be stable, its temperature must be reduced considerably below freezing point, and it is usual to allow another 8 thermal units for this. The specific heat of ice is approximately 0.5, so that one-half of a thermal unit has to be abstracted from every pound of ice to lower its temperature 1 deg.

In the practice of ice making, however, it is usual to employ water at very much higher temperatures than ordinary drinking water or that used for domestic purposes. It will be remembered that there are two reasons for making artificial ice. One reason is that it can be made as and when required, on the spot where it is to be used, provided that pure water for the ice and cooling water for the condenser are obtainable; and the other reason, which has received striking support by the action of the American government, is the fact that natural ice, ice formed in rivers, lakes, etc., is often found to contain disease germs. Low temperatures are very good for preventing bacteriological action, for preventing the multiplication of the bacteria which are active in any particular disease; but while low temperatures restrain their multiplication and in many cases prevent it, they do not always kill them. There are bac-

teria belonging to some diseases that are able to resist the lowest temperatures that are present in natural ice. The result is that, while the bacteria are practically asleep when contained in the ice, they come to life again when the ice is melted, and, as is well known, propagate disease. It is claimed, and with justice, that artificial ice can be made perfectly pure.

And here comes in another important point that must be carefully borne in mind when laying out an ice plant. The water from which the ice is made must be absolutely pure, and in addition all air must be expelled from it. One of the reasons for adding an ice-making plant to an electric generating station is the fact that the exhaust steam may be used in the production of the ice. The process of generating steam and condensing it is the same as that of distilling, and therefore if the process is properly carried out the water should be perfectly pure. Where, as frequently happens, there is not sufficient exhaust steam to furnish the necessary quantity of water for ice that can be sold live steam is often taken from the boiler for the purpose, or a distilling plant is added. In cases also where exhaust steam is not used for the ice a distilling plant forms a necessary adjunct to the ice-making plant.

As readers of the *Electrical World* are aware, however, exhaust steam and the water formed by its condensation are by no means pure, particularly when they come from reciprocating engines. All engines require lubricating, and reciprocating engines particularly so; and a portion of the oil employed in lubricating the cylinders is converted into vapor and passes into the exhaust with the steam. All gases—and steam is a gas, it will be remembered—have the property of absorbing the vapors of other substances. The quantity of the vapor of other substances which they absorb depends upon their temperature, usually rising rapidly as the temperature increases, particularly with high temperatures. At the high temperature which characterizes even exhaust steam a certain quantity of the vapor of the lubricating oil is always absorbed and carried into the condenser. One of the troubles met with in keeping surface condensers efficient is the fact that the deposit of a fine film of oil upon the steam side of the condenser pipes increases the thermal resistance and lessens the effect of the cooling water. It may be mentioned, *en passant*, that ice for certain purposes may be made from the ordinary town's water supply without any purification. It is the ice that is to be used for cooling drinks or to be brought into close contact with food that requires to be made from absolutely pure water. Ice that is used in what are called refrigerator cabinets, the chests that one sees in hotels, in which small articles of consumption are placed, the cabinets being insulated thermally and provided with a supply of ice in a bunker to keep the temperature down, may be made from town water.

Perhaps three other points had better be mentioned before passing on. First, there is the question of the quantity of ice that can be made. There are, of course, two policies that may be followed in laying out an ice-making plant in connection with an electric generating station. The ice produced may be limited to the quantity of water available from the exhaust steam, or, if a good trade in ice is likely to be obtained, all the ice that can be sold may be arranged for. In the second case, as already indicated, either live steam from the boiler must be used to make up for the shortage in exhaust steam or a separate distilling plant must be added. The second point that should be considered is that the sale of ice will be largest during the summer months, when usually the exhaust steam from a generating station devoted principally to lighting is at its lowest. If the generating station also furnishes motive power, either for cars or for factories, the difference between winter and summer will probably not be great. If the other conditions warrant it—if upon a careful estimate, notwithstanding the additional cost, a profit is shown—ice may be made right through the year, stored in ice houses and sold during the summer. The third point that requires careful attention and may be a very serious one for the central-station engineer is the fact that in ice making there must be no break in the supply of power to the refrigeration compressor, if one is used. The ice blocks take lengths of time ranging from twenty hours up to as much as ten days to produce, and it is of the greatest importance that there should be no break in the delivery of the cold current, if the expression may be pardoned, to the water from which the ice is being made. If any break occurs the ice will be formed in laminas, whereas it is the essence of good ice, no matter for what purpose it is required, that it should be turned out in solid blocks. Incidentally, again it may be mentioned that there is a plant on the market in the United States by means of which ice is made in shreds and delivered by a conveyor to a hydraulic press, where it is squeezed into blocks of certain size, any water that may be present being expelled and, it is claimed, a very good result being obtained. The question, however, of the continued supply of energy to the compressor affects the central-station engineer because of his peak load. He must face the question that the ice plant must be run continuously, or he will have trouble with his ice consumers. It is not difficult, of course, to arrange that the energy shall be available even during peak load, but it means extra plant, and again the question must be carefully gone into, whether the ice-making installation will pay in spite of this, or whether it can be run at times of light load. A suggestion concerning this is made later in the article.

PURIFYING THE WATER FOR THE ICE.

Central-station engineers are already familiar with apparatus for extracting the oil from the steam before it passes to the condenser. The same apparatus is used in the preliminary portion of the process of purifying the water for ice making. Everything that can be done to eliminate oil, even in the very smallest quantities from the water, is good; also anything that can be done to abstract from the water other substances which come over with the steam, such as oxides of the metals. The abstraction of the oil, however, is only a very small part of the purifying method. The condensed water, if allowed to remain as the oil separator leaves it, would produce ice that would be unsalable and unusable. It is usual to submit the condensed water to a process of reboiling, skimming and a very thorough filtering after reboiling and skimming have done their utmost.

Another point had better be made here. Where the condensed water from exhaust steam is employed it is usual to sacrifice a certain portion of the vacuum and its economy in order to provide the pressure for driving the steam and condensed water through the different apparatus. It is usual to arrange a relief valve at the end of a pipe carried up to the top of a building and loaded to about 5 lb. per square inch pressure, so that the back pressure in front of the pistons of the reciprocating engines is slightly increased above that which would rule if the full benefits of condensation were taken by the engine. The relief valve allows the exhaust steam to pass to the atmosphere if anything is wrong with the purifying plant. The pipe leading to the relief valve is tapped at a convenient point, preferably at a moderately high level, and the steam is taken from that to steam separators, or steam scrubbers, as they are sometimes termed, whose office is to remove as much of the grease and other impurities as possible. In modern practice, also, it is now usual to pass the steam through a second set of what are really steam separators but are termed purifiers. They are usually cylindrical vessels partly filled with materials such as cut straw, coke, pumice, broken bricks or other substances that will take up any grease or other impurities that remain. It will be understood, again, that the elimination of oil and other impuri-

ties at as early a stage of the purifying process as possible is a great advantage. The steam is usually then taken through a feed-water heater, through which the feed water for the boiler is passed, with the double object of lowering the temperature of the steam before it enters the condenser and of raising the temperature of the feed water. It then passes to the condenser, which must necessarily be of the surface type, though it may be an evaporative condenser or an inclosed condenser. Evaporative condensers, in which the condenser pipes are exposed to the atmosphere and the cooling water trickles down over them, the major portion of the cooling effect being produced by evaporation of the cooling water, are rather favorites with the refrigeration engineers. It does not matter which form of surface condenser is employed. From the condenser the condensed steam passes usually first to a skimmer. The skimmer is the first of two vessels employed in the process of reboiling. It is sometimes omitted, the process of skimming being entirely carried out in the main reboiler. The skimmer is again a cylindrical vessel into which the water formed from the condensed steam passes and in which it is heated by a steam coil. Oily matter and similar substances rise to the surface of the water and flow over a lip provided for the purpose, the remainder of the water passing to the reboiler proper. In the reboiler the water is again raised to boiling temperature and the surface skimmed for any further foreign matter that may be present. The principal object of the reboiler, however, is to drive off any air that is present in the water. It will be remembered that one of the difficulties attendant upon the condensation of steam is the presence of air which has come over from the boiler with the steam and which has to be withdrawn by an air pump. As the condenser in this case is not required to furnish a vacuum the air is not withdrawn, and it has to be got rid of in some other way. All air must as far as possible be expelled from the water before it enters the tanks in which the ice is to be formed, or the ice itself will be cloudy. In the process of reboiling nearly all the air is driven off. It is claimed that if the skimming and reboiling are properly carried out no air or other impurities remain in the water. The purified water is then cooled by being passed through what is really another surface condenser, usually of the evaporative type. It then passes through one or more filters, and then to the fore-cooling tank, a tank into which it is delivered previous to its entry into the ice-making tank. It will be seen that the fore cooler is practically a reservoir, and it is necessary to have such a tank to receive the water which comes over from the engines as it is formed and purified. The fore cooler is also made use of to lower the temperature of the water previous to its entering the ice tank proper. There are differences of opinion among refrigeration engineers as to whether this is wise or not. It is almost the universal practice, however. The water in the fore-cooled tank has its temperature lowered, either by a coil or grid of pipe in which cold brine is circulating, or, where economy is studied very carefully, by a similar coil of pipe through which the cold gas from the ice tank or the brine tank passes on its way to the suction valve of the compressor. It is important that the water in the fore-cooler tank should be thoroughly protected from the possibility of dirt or other foreign substances getting in, and it should also be protected as far as possible from the air. As is well known, air is dissolved in water, and if the water remains in the tank for any time exposed to the air the ice formed from it will not be so good as if the air had not been allowed to enter. The principal reason for cooling the water in the fore cooler is to lessen the amount of cooling which has to be done in the ice tanks themselves. The objection to it is the fact that the cooled water has a greater capacity for absorbing air and other gases than water at the higher temperature. As usual, it is a question of striking a balance between the opposing objects.

METHODS OF FORMING THE ICE.

In America there are two principal methods of forming the ice blocks—what is known as the "can" system and the "plate" system. In the United Kingdom what is called the "cell" system is also used. For small installations, such as would be added to electric generating stations of small cities, probably the "can" system will be best. In the "can" system, as its name implies, there are a number of cans placed in the ice tank. The cans are of galvanized iron and are constructed of pyramidal shape, the bottom being smaller than the top. They are also designed to offer as large a surface as possible to the action of the cold brine which surrounds them. For that purpose they are made comparatively high and wide and narrow. The following are some of the sizes of ice cans made: 24 in. by 12 in. by 6 in.; 32 in. by 18 in. by 8 in.; 32 in. by 22 in. by 11 in.; 57 in. by 22 in. by 11 in. It will be seen that the form of the cans gives as large a surface as possible for a given weight of ice. The weights of the blocks of ice made in the cans whose sizes are given above are, for the 6-in. can 50 lb., for the 8-in. can 100 lb., and for the 11-in. cans 200 lb. and 400 lb. respectively. The reason for the large surface in the cans is that ice itself has a very low thermal conductivity, and as the water next the containing metal freezes first there is a gradual thermal resistance built up as the formation of the ice proceeds. Making the block thin in one direction reduces the effect of this thermal resistance to a minimum. The cans may either stand upon the bottom of a containing tank—this is the usual American method—or they may be suspended from rods or bearers supported by the top of the tank itself. The latter method has the advantage that the cooling liquid passes under the bottom of the can as well as round the sides. The times required to freeze the above ice blocks may also be interesting. The 6-in. can, making a 50-lb. block, requires twenty hours; the 8-in. can, making a 100-lb. block, thirty-six hours; the 11-in. can, making a 200-lb. block, fifty-five hours, and the 11-in. can, making a 400-lb. block, sixty hours. The above figures show the difficulty that will face the central-station engineer, but they also show the way out. As his peak load in summer will occupy only a small part of the twenty-four hours it should not be difficult to design a can that can be run from the time the peak comes off to the time it starts again, making its block of ice during that period.

The usual method when making can ice is to fill alternate cans at first and to withdraw alternate cans when frozen. This arrangement has the advantage that the load upon the refrigeration compressor is more equal throughout the run of the plant. As the ice forms in the cans a thermal resistance is set up, which reduces the rate of work the refrigerating plant is able to accomplish. By withdrawing alternate cans the load is more equalized. The can system, with cans arranged on the lines suggested above to run during the off-peak load hours, will probably suit small central stations and even those of fairly large size.

THE PLATE SYSTEM.

In the plate system, as the name implies, the ice is built up in several large plates. The ice tank is divided into sections by pairs of plates, forming practically iron boxes, in which the cold brine is circulating. In some cases the cold brine circulates in a pipe grid faced by a flat plate. In either case the ice grows upon the face of the plate to the thickness required, and when that is reached hot brine is sent through the cooling pipes, releasing the block of ice, which is then hoisted out.

THE ICE TANK ITSELF.

The ice tank itself should be insulated, very much on the lines that a cold store is, as it is necessary as far as possible to prevent heat passing into the water from which the ice is being formed from outside, as this lessens the

work which the refrigeration compressor has to perform. In some cases, however, the writer is informed that the ice tank is not insulated. It simplifies the construction not to do so, but it gives more work to the refrigerating compressor and whatever may be driving it.

There are a number of accessory apparatus required with an ice-making plant. Where the can system is used a special arrangement is employed for filling them. An agitator is also used in many forms of can ice-making plant to keep the water in motion and to expel the air while the ice is being formed. With plate ice it is claimed that the manner in which the ice is grown upon the plate forces the air outward. In plate ice making it is sometimes the practice to arrange the plates fairly near together and to allow the two bodies of ice to join in the middle. This does not make such a good block as the pure plate system, by which perfectly transparent ice is said to be made.

Apparatus is required for thawing out, for lifting the cans out of the ice tank and replacing them, for lifting the large blocks formed on the plate system, for breaking up the ice into small pieces, and for other purposes.

It should also be noted that, if preferred, what is known as the absorption system of cooling may be employed. In the absorption system, which is only applicable with ammonia, the ammonia gas is alternately absorbed in a tank of water and expelled from another tank under pressure. The generator, as the tank in which expulsion takes place is called, is virtually a boiler, and the ammonia gas is driven off under pressure, the generator taking the place of the compression part of the compressor. The absorber, as the other tank is called, takes the place of the suction side of the compressor. The generator in an absorption system is heated by steam.

Where ice is stored, as where it is made right throughout the year, so as to have a good supply during the summer months, the ice house in which it is stored must be insulated just as a cold store is. Almost any building can be converted into an ice store, provided that it can be insulated. Insulation consists in building a wall of insulating material inside of the usual brick or wood or other walls, and also providing an insulating floor and roof. The method that has been adopted until very recently is to line the brick, stone or other wall with wooden match boarding, inside of which waterproof paper is pasted. A second wall of wooden match boarding is built at a certain distance, depending upon the conditions, from the lining of the outer wall. It is stayed to the outer wall and pasted on the side facing the outer wall with waterproof paper. The space between the two walls of match boarding is closely filled with one of the thermal insulators, silicate cotton, flake charcoal, cork, etc. The last-named method, which has the advantage, in the writer's opinion, of making a better mechanical job and being more easily applied, is to make sheets of compressed cork of various thicknesses and various sizes. They can be cut with a saw and drilled, and will hold a coarse thread. The sheets or slabs are fixed upon the inside of the brick or stone or other wall by screws or in any convenient way to the thickness required, and a special form of cement that has been worked out for the purpose is laid on over all on the inside, so that there is a smooth surface. Floors and roofs are treated very similarly to walls, but provision is made for walking upon the floors by laying asphalt or some other substance above the thermal insulator, and provision is made in the ceiling for any attachments that may be required to hold the material stored without affecting the insulation of the roof. In hot climates also and where the sun is very powerful during the summer the roofs of the ice house should be protected by asbestos tiles or some similar substance. For moderate climates a dug-out makes a very fair ice store, but the roof and any walls that rise above the ground should be insulated in the manner described.

SWITCHBOARD PANELS FOR THREE-WIRE GENERATORS.

Various Methods of Connections, with the Economic and Practical Advantages of Each Method Explained.

By A. M. Bennett.

THE design of switchboards for the protection and control of three-wire generators presents a case analogous in principle to that of the two-wire switchboard. The same protection against overloads, usually in the form of circuit-breakers, is necessary; provision must be made for throwing the machine into circuit after its voltage has been adjusted, and in addition instruments must be provided for indicating the current output and voltage. The generator panel for the two-wire installation has been quite generally standardized, the following being the equipment usually found thereon: A double-pole switch, controlling one line and the equalizer;

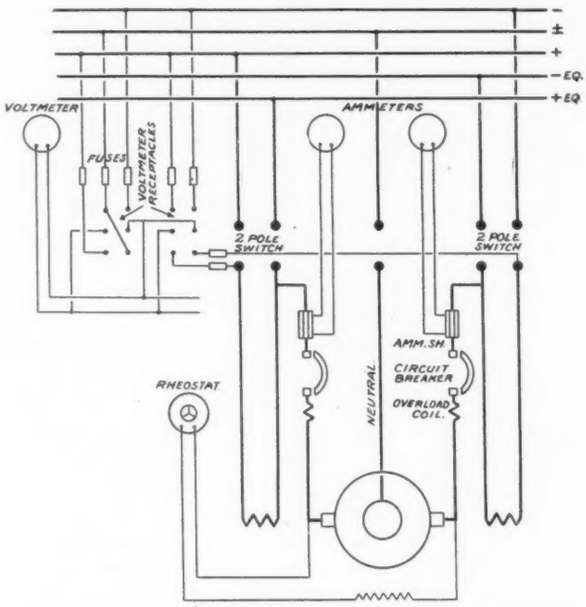


Fig. 1—Diagram of Connections for Three-Wire Generator.

a single-pole switch and a single-pole overload circuit-breaker, together with the ammeter, being placed in the other line. A voltmeter is so connected that the voltage may be read before the generator is thrown into circuit. The field regulator and ground detector lamps complete all the apparatus necessary for the absolute control of the current from the two-wire generator that is to operate in parallel with others.

In view of the fact that in the majority of installations at the present day the generators are operated in parallel, and in those cases where single operation does obtain the machines are so designed that equalizing connections can be made if needed, the descriptions to follow will deal with the case of compound-wound generators in parallel operation.

With three-wire generators it is necessary to have two equalizing connections between machines, this being due to the fact that the series field coils are so connected that alternate poles are in series. Two sections are thus formed, one of which is connected to the positive and the other to the negative side of the armature. As there is an equalizer on each side of the generator it will be seen that the full potential of the generator exists between the two. The same treatment as regards mounting, spacing, etc., should be accorded these connections as the main leads from the machine.

There are several arrangements of switchboard apparatus which are in common use, differing in the number of leads required to be run from the generator, in the location and number of circuit-breakers used and in the switching facilities afforded. The primary object in all of these should be protection of the generators, but that some fall short of this design can easily be shown.

The one arrangement which does fully satisfy this requirement of protection and at the same time provides adequate switching facilities is shown diagrammatically in Fig. 1. It will be seen that seven leads are run between generator and switchboard, and the equipment may be described as the result of filling certain conditions which it is known must exist in order that full protection to the generator may obtain. These conditions are described herewith.

Inasmuch as a complete circuit exists from either side of the machine through the neutral lead, it is necessary that each of these circuits be protected. From this it is seen that the least number of circuit-breakers that can be used is two, and that these must be interlocked so that both open at the same time, for if the circuit from one side of the armature only were opened the full load from the other side of the system would flow through the balancing coils and their connections, overloading them and probably burning them out.

To carry out the full intent in the use of circuit-breakers, that of protection to the generator from overload, it is necessary that they be acted upon by the full armature current. To meet this condition it is evident they must be placed in circuit between the armature and the point where the equalizer is taken off; otherwise the current flowing in the equalizers will not pass through the circuit-breakers. In this case if a machine is delivering current through the equalizer to another in parallel with it the first machine is not protected by its circuit-breaker by the amount of this current, while this extra current may cause the breaker of the second machine to open, though this latter machine itself may not be overloaded. It is necessary then to run leads from each side of the armature to the circuit-breakers on the switchboard and back to the series field coils, thence again to the busbars on the switchboard. The equalizing connection is then made at the switchboard instead of at the machine terminals.

With the generator protected as thus described a circuit-breaker is not needed in the neutral; in fact, one should not be used unless it is arranged to trip the main-line breakers at the same time. If this were not done the opening of the neutral alone would throw the neutral load across the outside mains, with probable injury to this load.

As with the two-wire generator, the main switches should be so arranged that the series field coils can be connected to the line when starting up. This is effected by placing a double-pole switch in each side of the system, one pole in each main and equalizer lead, as shown in Fig. 1. The circuit-breakers must be open until the voltage has been built up to that of the line, after which they can be closed, throwing the generators on to the line. If the circuit-breakers were closed at the time of starting, the armature of the machine, being paralleled, would act as a short-circuit to the rest of the machines on the line.

A single-pole switch in the neutral is all that is required to disconnect the balancing coils from the circuit. In case these coils are external to the machine it is not necessary to introduce switches in the leads between them and the collector rings. If it is desired to open these circuits it can be done by lifting the brushes from the collector rings.

The opening of the circuit-breakers in this method of connection leaves the series field coils connected to the lines, and this has led in some cases to an extra connection being placed on the circuit-breaker to open the equalizer leads. This addition, however, is more in the nature of a refinement than a requisite, and should not be considered a necessary part of the apparatus on the switchboard, as these leads can just as well be opened by means of the switches connected in them.

Inasmuch as there is a difference of current on the two sides of a three-wire system when the latter is carrying an unbalanced load, which difference is the amount of current carried by the neutral, it is necessary to have an ammeter in each main from the generator. For these ammeters to indicate the full current in each side of the system they must be connected in circuit after the same manner as the circuit-breakers; that is, between the armature and the equalizing connection. In this case the meters and their shunts can all be mounted on the switchboard, which cannot be done in certain systems of which descriptions will be given later.

The voltmeter is usually connected to read the voltage, both at the machine terminals and at the busbars on the switchboard. In addition, means should be provided for reading the voltage between mains and neutral, as a difference in voltage exists between the two sides of the system, depending on the amount of unbalanced load carried.

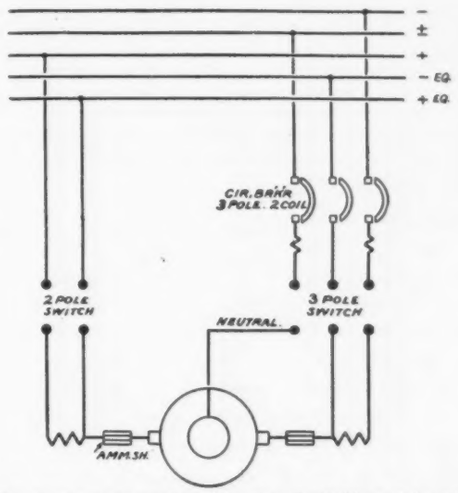


Fig. 2—Arrangements with Five Switchboard Leads.

These readings can all be made on a single instrument by the use of voltmeter receptacles and plugs, as shown in Fig. 1.

The above method of connection, while insuring the best possible protection to the generators by reason of the fact that seven leads are required, will be found to be expensive in the case of large installations and where the cables are of large current-carrying capacity, and in many cases of this nature it is the practice to install the circuit-breakers and ammeter shunts on a separate panel near the generator, instead of on the switchboard. By this means two of the seven cables are done away with. As the cost of the extra circuit-breaker panel is more than offset by the saving in cable, and as the former does not take up much room near the machines, the method is to be recommended. It will be seen that this is only a variation of the scheme previously described and sacrifices none of the protection afforded by it.

An equipment in which only five leads are required and where all the apparatus is mounted on the switchboard is shown in Fig. 2. It will be noted that a three-pole circuit-breaker is used, and this has but two coils, one in the main line and one in the neutral. The breaker in this case is not influenced by the full armature current from a machine which is delivering current by way of the equalizer to others, while the machine receiving current through the equalizer may have its breaker opened when this machine is not overloaded. The circuit-breakers then do not protect the generators by the amount of equalizing current passing between them. The circuit-breakers in this case

must be interlocked; otherwise the one in the main line may open, leaving the circuit through the neutral and the other side of the machine undisturbed, with probable injury to the balancing coils, and, vice versa, the neutral may be opened, throwing the neutral load across the outside mains. It is understood that when the main-line circuit-breaker is opened it must actuate the one in the equalizer.

It will be noted that the switches when closed on the series field also establish a circuit through the machine, and for this reason it is not possible to start up the generator with the series fields in circuit, as can be done with the arrangement shown in Fig. 1.

The ammeter shunts have to be mounted on the generator frame and connected in circuit between the armature and equalizer, in order that the ammeters may indicate the full current on either side of the system. This necessitates special arrangement of the terminal blocks to take these shunts and special calibration of the ammeters, on account of the long leads required. To this must be added the extra cost of the circuit-breaker over that required with the seven-lead arrangement. When this is all taken into account, together with the fact that absolute

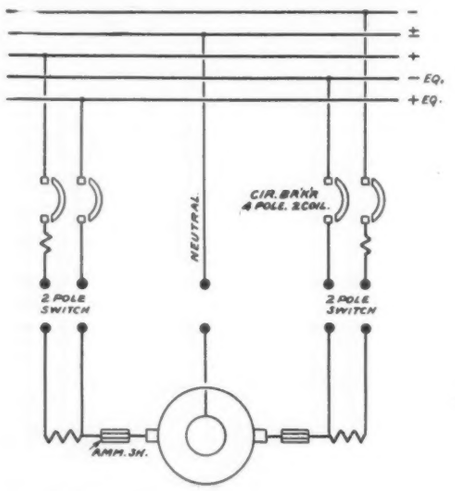


Fig. 3—Three-Wire Generator with Four-Pole Circuit-Breaker.

protection is not afforded to the generators, it is evident that this method of connection is not as desirable as that shown in Fig. 1, even though the smaller number of leads required effects some saving in cost.

An equipment quite commonly used is shown in Fig. 3, where a four-pole circuit-breaker and two double-pole switches are used in the main and equalizer leads. This arrangement also requires that only five leads be run to the switchboard, but it is open to all the objections described under the previous case, and in addition introduces another pole in the circuit-breaker.

The equipments described all resolve themselves into a single case when the generator is to operate singly. As there are three leads from the generator, including the neutral, a three-pole switch is required. A circuit-breaker should be placed in each main, and these must be interlocked for reasons stated previously. This apparatus, together with the ammeter shunts, can all be mounted on the switchboard.

The question of panels controlling feeder circuits will not be considered in detail, as these vary with conditions governed by the size of the plant, the nature of the load, etc. Their design does not present any difficulties over that of the two-wire system. In large installations the power panels and those supplying lighting circuits are arranged separately, and each may be equipped with its own ammeters and wattmeter.

COMPARISON OF COMMERCIAL ECONOMY OF GAS ENGINES AND STEAM TURBINES.

Practical Data Relating to Operation of Blast-Furnace Gas Engines with Electrical Generators.

By Franklin M. Farwell.

IN these days when the gas engine has become so popular as a prime mover for electric generators, particularly when blast-furnace gas engines in iron and steel works have become so common, some important considerations in the cost of producing electric energy seem to have been overlooked. The high thermal efficiency of the gas engine over other forms of heat engines seems in the mind of many to overshadow all other points. Such should not be the case, for there are other items eminently worthy of attention which may put an entirely different face on the situation. While it is perhaps true that in a good many cases the high thermal efficiency of the gas engine becomes the governing factor in its selection as a prime mover, yet there are cases in which other factors seriously reduce this beneficent result if they do not entirely eliminate it.

In the design of a generating system, if worked out according to correct engineering principles, there can be no standard practice. Local conditions must be carefully investigated. This is especially true in industrial works where the waste or refuse of the industrial processes may be used in generating electrical energy or where the processes of manufacture may require such large quantities of energy in a certain form as to govern the type of prime mover used. In industrial plants these things alone are often considered the determining factor in the selection of a prime mover.

There are, however, other items besides the form of fuel or energy used that should be looked into. In view of this the writer desires to call attention to a few points with special reference to the use of blast-furnace gas engines as prime movers that have come to his notice in the past two or three years in making estimates for extensions to a large generating system and from experience gained in the operation of such a system. These points, the writer believes, are sufficiently important to be of interest to the engineering profession at large and particularly to the engineers who are connected with industrial works of various sorts.

The first item worthy of note is the relation between fixed charges and operating cost. A gas engine using waste gases is a very bulky and expensive affair, requires a large and expensive building to house it, and of necessity must cover a large ground area. On the other hand, the steam turbine is a very simple and inexpensive machine and on account of its natural characteristics requires very small space.

In cases where land for the power-house site must be purchased the matter of ground area may become of considerable importance where the price of real estate is high, but in the specific case here mentioned it is not considered, as it is assumed that the company has sufficient area available for either kind of power station.

A prominent electrical engineer engaged in steel-mill work gives the following figures for the cost per kilowatt of moderate-sized alternating-current generating stations for steel and iron mills: If driven by blast-furnace gas engine, $130 per kilowatt; if driven by reciprocating steam engine, $95 per kilowatt, and if driven by low-pressure steam turbine, $75 per kilowatt. These figures are for the total cost of generating station divided by the total kilowatt rating of the station, including spare units. Now, in place of the low-pressure turbine assume the use of the high-pressure steam turbine, which would cost a little more, say

$80 per kilowatt.[1] It is readily seen that the gas-engine plant will cost 62.5 per cent more than the steam-turbine plant.

The writer does not wish to discuss here the question of depreciation, but it would seem to be the general consensus of opinion of those most closely in touch with business engineering that some allowance must be made for the replacement of worn-out and obsolete machinery. Science and invention are so rapidly improving our arts and industries that it often becomes advisable to consign to the scrap heap machinery that is far from worn out. Under these conditions the charge against the investment should be high.

On this basis, then, will be examined the two extreme cases to see where they lead. A certain large and well-known steel company in making estimates allows for power-station equipment: Depreciation, 10 per cent; interest, 5 per cent, and taxes, 1⅛ per cent. No allowance is made for insurance, but the writer believes it should be included, even though in this case the steel company has its own insurance department. For this discussion, however, it will be omitted, the other items being assumed to be sufficient to cover it.

In the case of the gas-engine station the charge against investment would then become:

Depreciation at 10 per cent	$13.00
Interest at 5 per cent	6.50
Taxes at 1⅛ per cent	1.46
Total	$20.96

On account of the fewer parts exposed to high temperatures and to wear, and the extreme simplicity of the steam turbine, it would seem to be safe to cut the depreciation to 9 per cent for that case. The charge against investment for the steam turbine station would then become:

Depreciation at 9 per cent	$7.20
Interest at 5 per cent	4.00
Taxes at 1⅛ per cent	.90
Total	$12.10

This shows a large difference in the amounts charged against investment. Now consider the operating costs for a gas-engine station and afterward those for a steam-turbine station.

In a certain steel-works power plant of 6000 kw total rating using blast-furnace gas, with which the writer is familiar, the service requires the use of two of the 2000-kw units, leaving the third for reserve. With an approximate average load of 4000 kw on the station the yearly operating cost, as calculated from tests and cost reports of actual operating conditions, is as follows:

Wages and salaries	$11,790
Repairs	11,700
Lubricants and waste	6,000
Cooling water	2,850
Blast-furnace gas ($12,000 per engine)	24,000
Cleaning gas	10,000
Total	$66,340

As the rating of the station is being here used as a basis, the amount is divided by 6000 instead of the kilowatt output. Then $66,340 \div 6000 = \$11.06$, which is the operating cost per kilowatt per year.

Consider next a steam-turbine station of the same rating, same sized units and carrying the same load. The steam turbine has so few and such small bearing surfaces as compared with the gas engine, besides being almost entirely self-oiling, that one can safely consider one less man on each turn in the engine-room than would be required with gas engines, and can drop the least expensive man, whose wages would be about $575 per year; for the two turns, that would mean a reduction of $1,150 per year.

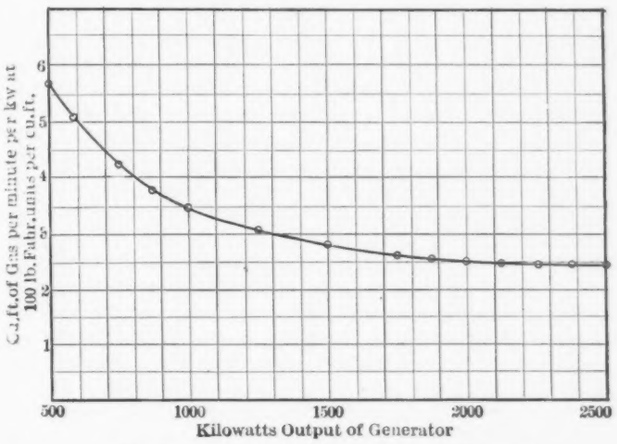
Then for the operating cost of the steam-turbine station the estimated yearly cost would be as follows:

Wages and salaries	$10,640
Repairs	5,850
Lubricants and waste	3,000
Condensing water[2]	9,690
Steam[3]	90,000
Total	$119,180

Now, dividing by the rating of the station, one has $119,180 \div 6000 = \$19.86$ per kilowatt per year for the steam-turbine station.

Combining these to obtain the total yearly cost of service per kilowatt, there is obtained for the gas-engine station $\$20.96 + 11.06 = \$32.02$, and for the steam-turbine station, $\$12.10 + 19.86 = \$31.96$, which shows $0.06 per kilowatt in favor of the turbine station.

It is worth while observing from the note regarding the cost of steam that the figure $90,000 is based on the use of coal under more than half of the boilers in the works and blast-furnace gas under the remainder. If the cost of steam from the gas-fired boilers were separated out and used as the figure for cost of steam to the turbines, as should be done to make a fair comparison, the steam turbine would show up still better.



Variation of Gas Consumption with Load.

The gas engine has not as yet been developed in extremely large units, while the steam turbine has. The gas engine has seldom been used in units larger than 2000 kw, while the steam turbine is made in 10,000 kw and even larger sizes. Now, if one were to consider a station of 30,000 kw, which is nearly the size of the famous Gary plant, and use three 10,000-kw turbine units as against fifteen 2000-kw gas-engine units, it would be found that with all other items remaining in the same ratio as given above the large number of men required for the gas-engine station and the improved economy of a 10,000-kw turbine over one of 2000 kw would make the favorable showing for the steam-turbine station still greater.

Another important item is the matter of power factor. In a certain steel-works power plant of 6000-kw rating familiar to the writer there are three units with generators rated at 2000 kw and gas engines rated at 3600 brake-hp. The efficiency of the generators being about 95 per cent,

[1]Various articles in the *Electrical World* would indicate that the cost figure chosen is a fair average.

[2]Cost of condensing water was calculated on the basis of thirty times the weight of steam condensed and is figured at the same cost per gallon as the water used for cooling in the case of the gas engines.

[3]Cost of steam is based on the consumption of 17.5 lbs. per kw-hour delivered at a cost of $32.33 per year per boiler hp. This figure is the average of all boilers in the steel works, some burning blast-furnace gas and some burning coal. From various published tests on steam turbines of about the size here considered the author believes that the steam-consumption rate he has assumed is a liberal one.

the normal load on the gas engines is approximately 2500 kw on the generator at unity power factor, the high rating of the gas engines being supposedly intended to allow for heavy overloads on the generators.

Now, these generators being rated at 2000 kw at 80 per cent power factor, the current output at 2500 kw with unity power factor would be just about the limiting current for continuous operation without undue heating. In this particular instance the load on the station is composed largely of synchronous motors, and by control of their excitation the power factor is maintained very nearly at unity.

Suppose now that the average power factor were 75 per cent, as is not uncommon in industrial plants having a large induction motor load. The continuous power output of the generator would then be $2500 \times 0.75 = 1875$ kw, and the load on the engine would be reduced in approximately the same proportion.

The mechanical efficiency of these gas engines being low (about 77.6 per cent) and the friction load high (about 920 hp, determined both by indicator cards and by driving engine with generator acting as a motor), the gas consumption on light loads becomes very high, as shown by the accompanying curve. This curve was made, not from test conditions, but from operating conditions, the points being plotted from the average wattmeter and gas-meter readings for twenty-four hours, corrected and reduced to a basis of gas at 100 heat units per cubic foot.

Consider now a concrete example. Suppose the station load is 5000 kw. At unity power factor this could be nicely handled by two of the units with 2500 kw on each. With a power factor of 75 per cent three units with a load of 1667 kw each would be required. From the accompanying gas-consumption curve the gas per kw-hour in the case of two units at unity power factor would be $2.45 \times 60 = 147$ cu. ft., and with three units operating at 75 per cent power factor the gas per kw-hour would be $2.68 \times 60 = 160.8$ cu. ft. Using the cost of gas per year, cleaning included, as given above in the estimate of cost of power, and the gas consumption taken from the curve, the cost of gas per cubic foot figures out to be \$0.00000665 and the gas cost per kw-hour would be for unity power factor $0.00000665 \times 147 = \$0.000977$ and for 75 per cent power factor $0.00000665 \times 160.8 = \$0.001069$. From this it is readily shown that the reduction of the power factor to 75 per cent increases the fuel cost per kw-hour to 9.4 per cent. In the case of 75 per cent power factor there would also be an additional expense for lubricants for the third unit.

The same thing occurs in the case of the steam turbine, but in a much smaller degree, first, because the steam turbine is able to handle greater overloads than a gas engine as at present rated and as a result it is customary to provide a generator with a turbine with a brake-horse-power rating just about equivalent to the rated output of generator plus its losses, and, second, the turbine has a higher mechanical efficiency and the steam consumption curve is almost flat between the load limits considered, and consequently the effect of power factor with steam-turbine units is not so pronounced in the operating economy.

When it comes to the matter of investment in the plant the question of reduced capacity on account of low power factor also becomes an important consideration in the selection of a prime mover. On account of the poorer mechanical efficiency of the gas engine and its inability to handle heavy overloads a prime mover of proportionately larger size will be required with the gas engine than with the steam turbine and still further increase an item already the chief factor in the total power cost.

There are two ways of meeting this problem of the relation of power factor to the prime mover. The first of these is to design the power station for unity power factor and so distribute the external load that there is a large proportion of synchronous motors operating under load which can be so excited as to keep the power factor close to unity, or else depend on a highly overexcited synchronous motor running light to correct for lagging current. The other method is to provide the generators with a prime mover of reduced size just sufficient to drive it at the inductive load expected where it is known that the power factor will be low.

Some engineers claim that an induction motor load is much easier to handle than a synchronous motor load, as the latter is more apt to exaggerate disturbances between machines operating in parallel, while the former will smooth out such disturbances, and they would therefore be apt to recommend the second method.

In the steel-works power system which has been frequently referred to the first method is in use. The larger part of the load being synchronous motors, the power factor was easily maintained very close to unity, and during all the writer's experience with this power system there did not seem to be an undue amount of interruptions to service that could be charged to the large synchronous load. No trouble whatever was experienced in parallel operation—in fact, in that power house is to be found one of the finest examples of parallel operation of alternators driven by blast-furnace gas engines in this country.

Of course, whatever kind of prime mover is used, the two methods for overcoming the effect of low power factor are applicable. In determining which method is to be used the character of the load on the station must be considered. The second method will, of course, be the more generally used, as the first method can be used only where the parties that control the generating station also can control the character of the load, as in large industrial concerns making their own power and in certain central stations where the load is of such a character as to admit of substations containing rotary converters or motor-generator sets instead of transformers. Of course, a synchronous motor running light to raise the power factor could be used in almost any case where the expense of such a motor would be justified.

There is much more that might be said regarding the choice of a prime mover for electric power stations, but the writer believes that the two points mentioned make it sufficiently clear that too much haste should not be made in selecting gas engines for prime movers even in steel works where the blast-furnace gas engine is expected to show such wonderful results.

The gas engine has a field of its own, where it is almost supreme, but this field decidedly is not large power plants at the present stage of the gas-engine-building art. In *Factory* for February, 1911, in an article by Prof. Hugo Diemer, appear some curves that illustrate this point very well. These show the total cost of power with various-sized units for both gas-engine and steam-engine plants at various prices of coal. With coal at \$2 per ton the gas-engine curve and the steam-engine curve cross at the 800-hp line. With sizes smaller than 800 hp the gas engine shows best, but above that the steam engine shows best. With higher priced coal the curves cross higher up, extending the gas-engine field. The same general law holds good whatever kind of gas is used or whether steam engines or steam turbines are used in the comparison, but, of course, the crossing point will vary, and it is close to this crossing point where the greatest care must be exercised in the selection.

The special case used by the author to illustrate these points lies very close to the line between the gas-engine field and the steam-turbine field. For that very reason it serves to show that careful consideration should be given to these points in the planning of stations of about that size. With plants much smaller or much larger the proper selection is not such a problem if low cost of producing power is the chief consideration.

ELECTRIFYING POPOCATEPETL VOLCANO.

By W. D. Hornaday.

An electrical project much out of the ordinary in its conception and features is that of a railway up Mount Popocatepetl, the proposed terminus of which is to be at the very rim of the crater of the sleeping volcano. It is authoritatively announced by Dr. F. S. Pearson, of New York, head of the English syndicate which owns the great Necaxa hydroelectric plant and transmission system and the extensive system of electric railways in the city of Mexico and the federal district, that plans have been adopted by his interests for the early construction of an electric railway between the city of Mexico and Puebla, with a branch line to run from Amecameca to the summit of Popocatepetl.

Besides the construction of this road it is the purpose of the Pearson syndicate to mine on an extensive scale the sulphur deposits that are stored in the crater of the volcano. This mining will be done by means of electric appliances installed at the outer rim of the crater and within the crater itself.

The reconnaissance for the proposed line up Popocatepetl was made several months ago by a party of engineers representing the Pearson syndicate, and their report shows that in mounting from an altitude of about 7000 ft. to that of about 15,500 ft. a grade of 5 per cent can be obtained. This will place the electric traction line upon the saddle of the mountain and within about 2300 ft. of the summit. The

Mount Popocatepetl Viewed from Amecameca.

acclivity of this final 2300 ft. is too great to be mounted by the ordinary traction method, and a cogwheel road will be constructed for that part of the line.

To realize what it means to connect the city of Mexico with the summit of the Popocatepetl volcano it need only be stated that it will enable people to change from a climate of a temperature of 60 deg. to 70 deg. to that of 10 deg. to 20 deg. below zero in a ride of two hours. Upon the summit and upper slopes of old Popocatepetl is a perpetual blanket of snow. Across its storm-scarred face sweeps a tempest of wind at all times. While its summit has been scaled by many persons, it requires no little hardihood and endurance to accomplish the feat. The volcano terminal of the proposed electric railway will be almost exactly 2 miles higher than the city of Mexico. Popocatepetl reaches an altitude 17,794 ft. above sea level. Upon the summit will be erected a large hotel for the accommodation of visitors. So far advanced are the plans that the type of coaches that is to be used thereon has been decided. The coaches are to be of unusually heavy construction with double window panes and electrically heated. The power for this line, as well as for the city of Mexico-Puebla road, will be obtained from the great Necaxa hydroelectric plant, which is now generating more than 100,000 hp.

It is claimed that the Popocatepetl sulphur deposit is the largest in the world and that it is being constantly added to through the congealing and precipitation of the sulphur fumes that the smoking mountain is constantly emitting. The sulphur of Popocatepetl's crater was first mined by the Spaniards under Cortez 400 years ago. In his campaign against the Aztecs he ran short of powder, and several of his men were sent to the summit of the mountain to procure sulphur for the manufacture of the necessary ammunition. Baron von Humboldt declared Popocatepetl to be the greatest sulphur deposit in the world. During the last thirty years that the volcano was owned by General Ochoa there was mined from the crater about 150,000 tons of sulphur. It is estimated that since the time of Cortez the crater has yielded more than 10,000,000 tons of sulphur.

The most primitive methods of extracting this mineral substance are in operation. Peons shovel the sulphur into bags and the latter are raised to the rim of the crater by means of ropes and then transported down the mountain upon the backs of laborers. The latter have a novel method of getting down the mountain. Each man seats himself upon a grass mat with a bag of sulphur upon his back and is given a shove upon the icy-covered ground and slides swiftly down the slope for more than a mile.

It is estimated by experts who have made a careful examination of the sulphur supply in the crater that it is being manufactured at the rate of approximately 1,480,000 tons per annum. Extensive equipment will be installed for the purpose of mining and hoisting the product to the surface. Some time ago the Mexican government issued a report which showed that at that time there were approximately 148,000,000 tons of sulphur in the crater, extending to a depth of about 700 ft. This is more than enough to supply the markets of the whole world. The annual consumption of sulphur in the United States is about 200,000 tons and in Europe about 350,000 tons per annum.

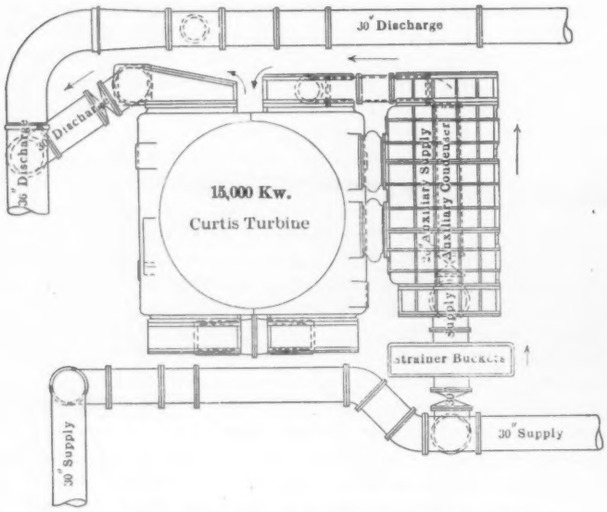
The snow line of Popocatepetl is usually at about 13,000 ft., although it has been known to extend considerably below that altitude. According to authentic records, Popocatepetl had notable eruptions in 1519, 1523, 1539, 1571, 1592, 1642, 1664, 1697 and in 1802. There has been no eruption since the last-named year, although at times there are manifestations of slumbering strength in the emission of sulphuric vapors from the many breathing holes in its crater. Liquid sulphur settles constantly around the holes. The sulphur-laid floor of the crater is about 550 ft. below the outer upper rim. The temperature at this depth is always comfortable. Aside from its commercial possibilities the volcano is one of the world's wonders.

EXTRA CONDENSER FOR 15,000-KW TURBINE.

The new 15,000-kw Curtis vertical steam-turbine set being installed by the Kansas City Metropolitan Street Railway Company in its Missouri River power station will be provided with the condenser from a former 5000-kw unit, in addition to its own base-type condenser. The water from the Missouri River carries a large quantity of sand and mud, and on account of the difficulty of cleaning condensers 1½-in. tubes have been the rule in the Kansas City station. The tubes in the new 15,000-kw units now being placed are 1¼ in. in diameter. To assure an ample margin of operation with this turbine the old 5000-kw condenser, which was available from the unit replaced, has been turned upon its side and used as the first pass in the new condensing system, as shown in the sketch.

Water is admitted from the 30-in. supply pipe through a multiple-bucket stream to the auxiliary condenser. This strainer is expected to arrest much of the material entering the condensers and can be cleaned without interfering with operation. From the far end of the auxiliary condenser

the circulating water enters the base-type condenser, through which it flows to the discharge line. By means of a by-pass the circulating water can also be diverted around the auxiliary condenser and delivered directly to the main unit. The steam spaces of the two condensers are connected through the 42-in. expansion joints shown. The 12-in. air-pump line will be tapped off from the auxiliary condenser, all air being removed at this point.



Arrangement of Auxiliary Condenser on 15,000-kw Turbine.

With the new 15,000-kw turbine, which has replaced a 500-kw unit, the total rating of the Missouri River power plant will reach 49,000 kw, and a second 15,000-kw unit has been ordered. Mr. Charles E. Fritts is chief engineer of the Metropolitan Railway Company.

HANDLING LUMBER WITH ELECTRIC MONORAIL HOISTS.

The Grayson-McLeod Lumber Company, of Graysonia, Ark., has a mile and a quarter of I-beam monorail track installed about its lumber plant, on which are operated three motor-driven telpher hoists for handling the stock from its dry-sheds and storage to the planing mill, sorters and kilns.

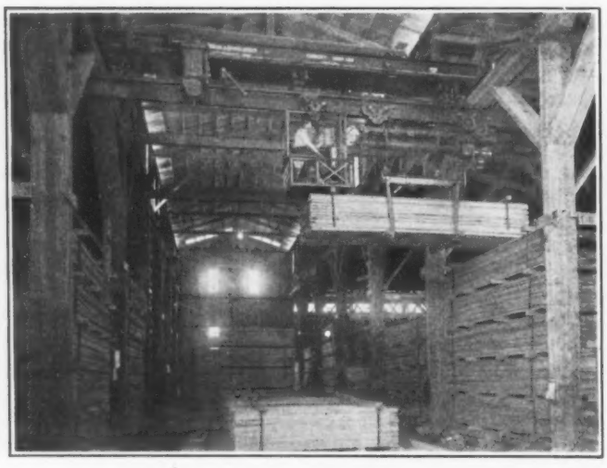


Fig. 1—Conveyor Hoist on Transfer Bridge in Drying Shed.

The lumber is piled in unit lots of about 1500 ft., or 3 tons, each. One of these units constitutes a load for the two-motor conveyors. Six-hp, 220-volt, direct-current motors are employed for the hoist motion and 10-hp units for the trolley travel. The conveyors traverse their I-beam tracks, which are at a height of 27 ft. above the ground, with a maximum speed of 900 ft. per minute.

In the rough dry-shed alone there is installed 3500 ft. of runway, in seven 500-ft. sections, each broken near its middle by an opening for the cross-travel of the transfer bridge by which the conveyors can reach any of the shed laterals. The transfer bridge is operated directly from the conveyor cab when in position, and is so interlocked that a conveyor cannot be run off the bridge until the latter is latched in place opposite a lateral branch runway. The trolley wire of this runway is also through this means energized, all the other runways remaining dead when not in use. With the bridge in its end approach position, all wires in the shed are dead.

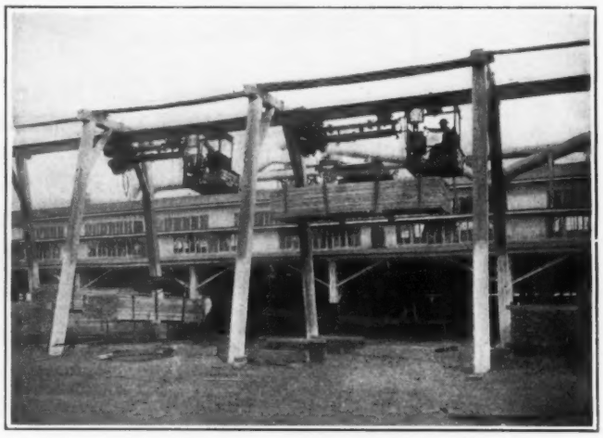


Fig. 2—Conveyor Hoists Picking Up Unit Piles of Lumber.

Fig. 1 shows the position of the lumber tongs spread between the 4-in. by 4-in. binders at the bottom of a unit pile. These hooks are operated from the cab, and the whole suspension is pivoted so that the load can be swung about to clear obstacles or pass through doors. A unit pile can thus be taken hold of, hoisted, conveyed, lowered and released by the operator alone, without the aid of a groundman. One conveyor hoist handles the lumber from the sorter shed to the planing mill; another works between the transfer platform and the rough dry-shed, the third being kept for helping out when the first two are busy. All parts of the 6000 ft. of runway are roofed, except the spur track shown in Fig. 2, so that the lumber is protected against rain and bad weather during transit. Fig. 3 gives a view of the great sorter shed, which is 900 ft. long.

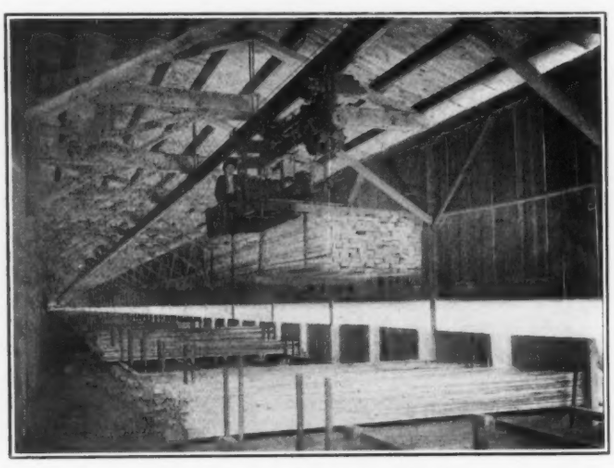


Fig. 3—Interior of Sorting Shed.

The mechanical conveyor system described works considerable saving in time as well as cost through handling the lumber in 1500-ft. or 6000-lb. units, instead of piece by piece, as by hand labor. The former cost of conveying lumber at the Graysonia installation is reported to have been 30 cents to 70 cents per 1000 ft., using lumber carts or dollies, but the motor-driven conveyors have reduced this to 5 cents to 6 cents per 1000 ft. It is of further interest to note that the first cost of the conveyor system was but little more than that for the mules, carts and tramways used with the old method of conveying. The conveyor hoists and transfer bridge at the mill of the Grayson-McLeod Lumber Company were built by the Pawling & Harnischfeger Company, Milwaukee, Wis.

LAYING OUT THE DISTRIBUTING MAINS OF A CENTRAL-STATION STEAM-HEATING SYSTEM.

When a steam-heating system is to be installed in a community where it has already been determined that conditions of compactness of customers, similarity of electrical and heating load curves, etc., make such heating service desirable, much care should be expended in laying out the steam mains and underground piping plant. The capacity of the mains especially should be gone into carefully. The tendency here, as in most construction, is to underestimate the future capacity required. Possible growth along the lines should be considered, as well as the present demand, and a happy medium struck. For it must be borne in mind that mains too small mean inadequate supply, high friction losses due to greater density and velocity of steam, and increased back-pressure against the engines. Too large mains, on the other hand, involve increased condensation and heat losses as well as extra, and possibly needless, first cost, as pointed out by Mr. A. E. Stevens, of Minot, N. D., in a talk before the Byllesby convention held recently at Chicago.

Properly laid out, the system can be made susceptible of much reasonable growth, parallel lines being laid on adjacent streets as the demands increase. These mains should be cross-connected at suitable points, thus allowing them to act as mutual boosters, equalizing the pressures and helping to supply the demand to all parts. This system of cross-connecting prevents "dead-ends" and provides proper circulation for the steam. This feature is often lost sight of, although of great importance. Steam in circulation is much more satisfactory than stagnant steam. Indeed, one of the gains by using exhaust steam from engine cylinders, instead of live steam through a pressure-reducing valve, is the pulsating effect from the engine exhaust which assists circulation.

In considering heat losses it must be remembered that these are practically constant, irrespective of the consumption of steam. Thus the percentage of loss is greatest when the load is a minimum. For mains up to one-half mile in length, with proper construction, the heat losses should not exceed 21 per cent at full load. Compared with the electrical distribution losses this is seen to be exceedingly good.

Iron pipe should be used, instead of steel, on account of superior lasting qualities. A good under-drainage system should also be installed, consisting of tiling draining into the sewer and covered with crushed rock or gravel. Too great care cannot be used in the establishment of proper grade for the mains. These should be laid without sags or pockets to hold water, and if possible all pipes should grade downhill to the plant. This feature is especially necessary where a water-return system is used. Drip traps should be located along the mains to carry off condensation, discharging either to the return pipe or through the sewer system.

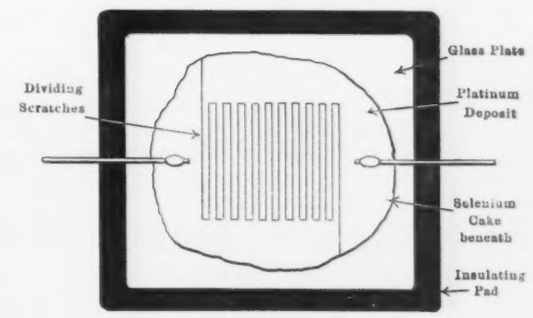
The service lines should be of sufficient size to handle the consumer's maximum demand and in all cases should grade up from the mains to the consumer's premises. These services should be insulated like the mains. A desirable feature is the installation of street-curb valves which give control of the service without entering the consumer's premises. A suitable trap should also be provided for the customer's installation, discharging into either the sewer or water-return pipe. This condensation may be passed through a meter where the customer is charged per 1000 lb. of steam used.

The installation of the consumer's equipment should be supervised, as far as possible, to secure proper radiating surface, drainage and general efficiency. In addition to the steam radiators, an economizer coil may often be installed to advantage in a flue connected with an ordinary hot-air radiator. The coil is so piped as to be continuously filled with hot water condensed from the steam, this water being made to give up a portion of its heat by such arrangement. Advice should also be given the consumer as to the most economical method of manipulating his plant. In this connection his attention should be drawn to the advantages of protection by storm windows and other provisions designed to prevent heat waste.

SELENIUM CELL.

The element selenium, as is well known, has the remarkable property of changing its electrical resistance with the intensity of light to which it is exposed. As the material itself is opaque and only its illuminated surface shares in these resistance changes, the design of an efficient photosensitive cell requires that the selenium be spread out in a layer as thin as possible. Again, on account of the normal high resistance of the selenium, the distance between opposite electrodes must be kept very short, with a corresponding large area of electrode contact.

To use the selenium to the greatest advantage, at the same time insuring a construction of cell free from probable short-circuits and troubles, Oscar Lindner and J. B. Replogle, of Chicago, Ill., have patented the method illustrated herewith. A thin layer of platinum is first deposited on a plate of glass. With a fine graving tool this metallic



Selenium Cell.

layer is scratched as shown, the end marks being carried to the edge of the platinum deposit so that two electrically separated conducting surfaces are left, divided by the great length of narrow tool kerf. Selenium in the plastic form is then pressed against the plate, adhering and filling the scratches. Here it can be converted into the more sensitive allotropic modification suitable for use in such a cell. Platinum or some other noble metal is required for the electrode material, on account of the tendency of selenium to form selenides with baser metals. The platinum deposit used is so thin that a certain amount of light will pass through it, affecting the surface of the selenium cake beneath and so increasing the efficacy of the cell.

Letters on Practical Subjects

A DIRECT-READING DYNAMOMETER.

In your issue of Jan. 6 (page 46) appeared an article by Mr. A. G. Bradbury with the above title which was quite interesting. However, the apparatus as there described possessed some disadvantages. Thus, it is not a dynamometer, properly speaking, but a torque meter. Further, the ammeter would have to be specially calibrated at all points, as the scale would not be uniform; and, in addition to this, the scale would have to be read in the reverse direction from the usual way, since for zero torque the current through the meter would be a maximum, while a zero current would imply infinite torque.

Some time ago the writer proposed a system similar to the one described, but differing in a few details, with the result that all the above difficulties were avoided. In brief, the mechanical details were substantially as described, namely, two co-axial shafts, the outer one rigid and the inner one flexible, these shafts being fastened together at one end and each carrying a disk at the other and having means whereby the relative motion of the free ends may cause a contactor on one disk to slide over a variable resistance on the other disk.

Instead of inserting this variable resistance directly in the meter circuit, it is connected across the source of emf, and the contactor taps off a portion of this emf proportional to the angular displacement of the contactor, on the well-known principle of the potentiometer. Thus, at zero torque the potential tapped off is zero, while as the torque increases the proportion of the total emf increases at the same rate.

Instead of using a constant potential on the drop wire, use is made of a magneto, to furnish a potential proportional to the speed. This magneto may be geared or belted to the shaft. A millivolt meter connected across the contactor circuit will now read proportionally to the power; the same instrument connected across the magneto will read proportionally to the speed, and by assigning suitable values to the resistances the same meter, calibrated to read in volts, will also read directly either power or speed on the two respective circuits. The proof is as follows:

E_m = magneto voltage = $K_s \times$ speed.

Torque = $K_s \times$ torsion.

Let R_t be total resistance and

R_e be portion tapped off by contactor = $K_t \times$ torsion.

Then voltmeter reads $\frac{R_e}{R_t} \times E_m$

$$= \frac{K_t \times \text{torque} \times R_t K_s \times \text{speed}}{R_t} = K \times \text{torque} \times \text{speed}$$

$= K \times$ power.

Wilkinsburg, Pa. Horace V. S. Taylor.

TROUBLE WITH UNEQUAL CLEARANCE ON AN INDUCTION MOTOR.

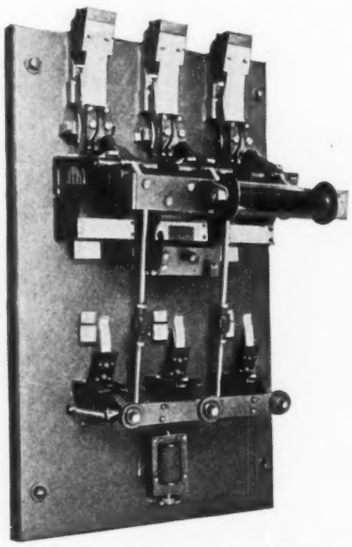
In our plant we have a 100-kw synchronous motor-generator set for supplying a three-wire direct-current system. A small induction motor is used to bring the motor up to speed for synchronizing. The synchronous motor has always run continually warm. Although we seldom have more than half load for it and keep several fans blowing on it continually in the summer, the temperature sometimes runs as high as 180 deg. Fahr., which is considerably warmer than the hand can bear. After the machine had been in service for about three years and a half trouble was experienced by the insulation breaking down owing to lightning or other disturbances, usually necessitating the rewinding of one or more coils. The matter was finally taken up with the manufacturers and the machine was tested by a young man sent out by the makers. Later on the machine was rewound, using superior insulation. After the machine was reassembled considerable difficulty was experienced in synchronizing; just as the motor came up to synchronous speed the starting motor would make a loud hum and immediately slow down, not giving one an opportunity to throw the motor switch in phase.

One morning the machine was particularly hard to put on the line after it had dropped out of step. After the machine was on the line again and the induction motor switch closed the motor made the same loud hum as before. For this reason the chief engineer thought the motor was getting energy from only one phase. I thought otherwise, because the machine started all right. I also thought that the reason it did not reach a higher speed was because the motor was not in alignment and the clearance not equalized for the reason that three liners were taken from under the motor. The expert replaced only one. However, I tested the phases and found them satisfactory. The machine dropped out of step again that afternoon, giving us the same experience as before, so it was decided to start the engine-driven generators and remedy the trouble if possible. After the liners were replaced and the motor realigned no further trouble was ever experienced in synchronizing.

Hutchinson, Kan. Grover M. Hardy.

STATION-SERVICE BREAKER TRANSFERS LIGHTING LOAD TO BATTERY

The circuit-breaker through which is supplied the station lighting of the new Lakeside generating plant of the Cleveland Electric Illuminating Company is so arranged that when it operates an auxiliary switch is automatically closed, completing the station battery circuit to a number of emergency lamps scattered through the building. The breaker, as illustrated, is of the 200-amp I-t-e type, with no-voltage release. All of the station circuits are fed through this switch. If the pressure goes off for any reason, the breaker trips out. The same motion acts to close the set of auxiliary switches seen below. These at once connect the station storage battery to the emergency lighting circuit, restoring energy supply to those lamps throughout the building which have been laid out with a view to emergency service. When a break-down or trouble occurs in a generating station light in the plant itself is most needed to restore service to the outside system. The switch shown insures that the auxiliary lighting will be



Breaker for Station Lighting Which Operates Auxiliary Battery Emergency Circuit.

available immediately in case of any trouble. When the main breaker is closed the auxiliary contacts are automatically opened.

Cleveland, Ohio. L. E. CHILDS.

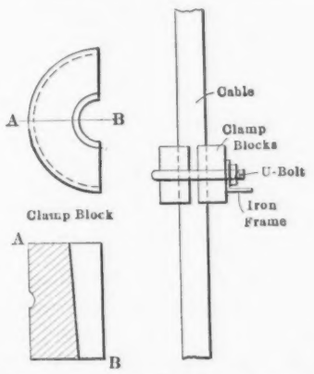
BALED-HAY FOUNDATION ABSORBS MACHINE VIBRATIONS.

Recently we installed a motor-driven molding machine in our foundry, but experienced much difficulty from its vibrations, which were transmitted to all parts of the pouring floor and even shook down molds waiting to be poured. The ground on which the foundry stands is peculiar. At one end it is underlaid by a fine quality of sand, splendid for molding purposes, which dictated the location of the plant at this place. But at the other end of the building there is a thick bed of soft clay on which it was necessary to foundation the molding machine. The latter comprises a heavy oscillating table, 5 ft. by 8 ft., the rapid motion of which compacts the sand around the pattern much harder than can be done with hand rammers. For the first foundation of the machine we had driven down a number of piles, but these quickly disappeared from view without appearing to take hold in the soft, jelly-like clay. The piles were capped with a heavy block of concrete as a bed for the machine. When the latter was started up all the floor around began to take part in a small earthquake. The vibration was felt throughout the shop and molds on the floor were quickly demolished. Something had to be done, or the operation of the molding machine given up altogether. At that rate it destroyed molds faster than it made them. Finally someone suggested the use of baled-hay cushions under the machine to absorb its oscillations. This idea came from a railroad track laid on bales across a stretch of quicksand. Later this was applied to the foundation of another vibrating machine and gave complete satisfaction. In our case it was also necessary to slow down the machine and reduce its amplitude, after which the vibrations ceased.

Sandusky, Ohio. T. K. ELLIOTT.

SUPPORTING CABLES IN VERTICAL RUNS.

The accompanying sketch shows the method of support we have used successfully where our 1,000,000-circ. mil cambric-covered cables undergo a vertical rise through about 50 ft. The circular clamping blocks are turned out of maple and afterward paraffined thoroughly. The inner opening of the blocks is given a diameter the same as the



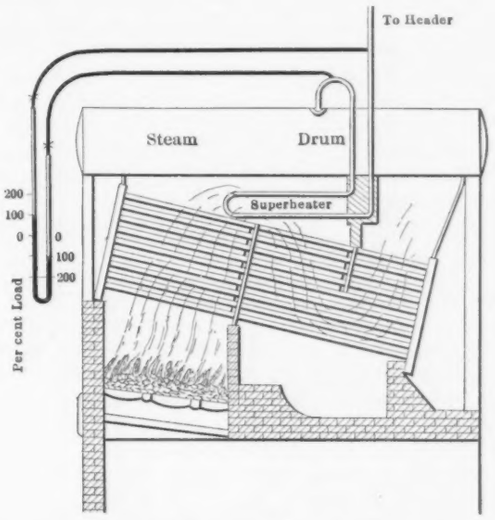
Clamping Block for Supporting Vertical Cable.

cable itself at one end, tapering slightly to a larger diameter at the upper end. U-bolts threaded on each leg and locked to the angle-iron framing with nuts serve to clamp the blocks together on the cable. An annular recess is grooved on the outside surface of the blocks to receive this metal shank. As shown in the magnified diagram, the blocks are placed with the inside taper so arranged as to grip the cable all the tighter under the weight of the cable itself or should there be any tendency for it to slip. This little "kink" of the inside taper will be found well worth the extra trouble, for it secures a rigid stationary position of the cable, insuring a construction that will not sag.

St. Louis, Mo. C. L. WILSON.

USING SUPERHEATER COILS AS VENTURI METER TO INDICATE STEAM OUTPUTS.

In a boiler equipped with a superheater the steam passing through the coils of the latter undergoes a pressure drop which is approximately proportional to the quantity of steam being delivered. The superheater can thus be used



Superheater Coil Used as Venturi Meter to Indicate Steam Output.

as the pressure-fall element in a Venturi-tube method of indicating the steam output of the boiler at any time. The superheater is already a necessary part of the equipment and so introduces no additional pressure loss into the line. The accompanying sketch shows how the respective pressures at the boiler proper and the superheater outlets can be tapped and connected to the two arms of a U-tube filled with mercury. The difference in elevation of the mercury surfaces will then indicate the quantity of steam being drawn from the boiler. The glass tubing and piping used must be stout enough, of course, to withstand the full boiler pressure of the steam and should be provided with stop cocks. Such a U-tube arrangement will be found of much convenience and satisfaction to the fire-room staff, showing the attendants at any time just how much load each boiler is carrying. With feed-water gages they should thus be able to adjust the water replacement exactly to the rate of steam output.

Grosse Pointe, Mich. MELVIN E. MERWIN.

LEAKY SAFETY VALVE.

A certain steam boiler was fitted with a pop safety valve which continually gave trouble by sticking and failing to work in as sensitive a manner as desired. Many times the valve was taken down, closely examined and found apparently in first-class condition, only again to "cut up" as soon as the steam was again up to the blowing-off point. After many weeks of mysterious action of the valve in this manner, the trouble disappeared as suddenly as it appeared and there was never any further difficulty.

After a long time it was decided that the trouble was due to the steam pipe which carried the escaped steam from

the valve to the outside of the boiler house. This pipe extended horizontally about 10 ft. through an opening in the wall of the boiler house; then the pipe terminated in an elbow which discharged horizontally.

It seems that the trouble was caused by the pressure exerted on the end of the 10-ft. escape pipe, the reaction of the steam issuing from the elbow at right angles to the length of the pipe causing sufficient force, after being imparted to the valve through the medium of a 10-ft. lever, to strain the casing of the valve enough to make the trouble mentioned above. Some changes in the boiler house caused the elbow to be removed from the end of the escape pipe, and, to the great astonishment and delight of the engineer and all concerned, the sticking of the valve ceased at once.

A somewhat similar instance was observed recently, in which the strains caused by an unsupported pipe caused trouble, not to the safety valve, but to the flange, riveted to the boiler, to which the steam pipe was bolted. In fact, the strains of the unsupported pipe caused leakage between the boiler neck and the shell to which it was attached. Many times expansion of the pipe causes strains and resulting leakage, but in this instance the leakage was caused solely by the unsupported weight of the pipe and ceased when the pipe was properly attached to a support.

Scranton, Pa. JOHN SCOTT.

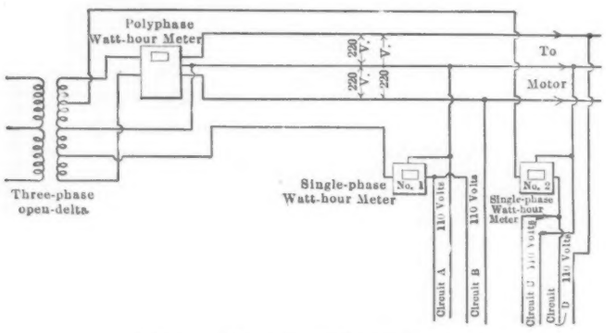
UNUSUAL METHOD OF METERING POLYPHASE ENERGY.

I recently discovered an installation supplying energy for lamps and motors from two transformers connected in open delta that is unique if nothing else. It seems to be an attempt to keep the lighting load as nearly balanced as possible on the two transformers and at the same time to use as little wire as possible.

The installation is in a sugar factory having an isolated plant for furnishing light. The "campaign," as it is termed, lasts from two to three months during the fall, but there are other times during the year when electricity for lighting and motor service is needed, so a contract was made with the central station for energy for a few small motors and also for a "throw-over lighting service" which is used during the daytime and when the lighting load is insufficient to warrant running the isolated plant.

Use was made of two transformers connected to a three-phase circuit in open delta, as shown in the accompanying sketch. A polyphase watt-hour meter was connected in the circuit near the transformers in the usual manner.

To supply 110-volt energy for lighting purposes the neutrals of the two transformers were carried alongside of one of the motor circuits to a point near the switchboard of the isolated plant. From this point four two-wire, 110-volt lighting circuits were taken to the switchboard, which was sectionalized into four sections.



Method of Metering Polyphase Energy.

Each neutral wire was run through the series coil of a single-phase watt-hour meter, as shown in the sketch, and formed one side of two circuits. The shunt coil was tapped to the middle leg of the motor circuit in both cases.

The trouble man in reporting on the lighting meters at the sugar factory said: "Part of the time they run forward, part of the time backward and part of the time they do not run at all."

It is obvious that when the loads on circuits *A, B, C* and *D* are balanced no current exists in the neutral wires, hence neither meter will register. At the same time the polyphase meter will record all the energy in the circuit. When the load in circuit *A* overbalances that on circuit *B* meter No. 1 will run forward and register the unbalanced portion of the load. When circuit *B* load overbalances circuit *A* load the current in the neutral is reversed and the meter will run backward. At the same time the unbalanced current is passing through one of the series coils of the polyphase meter, and as the short coils of the latter are across a 220-volt circuit the energy is recorded at twice its true value.

It seems to the writer that the three meters should register all of the energy coming from the transformers. However, I should not recommend this scheme as a practical one, and I have had it changed at the expense of unbalancing the loads on the transformers. It is liable to introduce complications that are unintelligible to the average meter reader and to introduce serious errors, particularly where the meters are read only once a month. In case the total unbalancing for the month were such as to make one of the meters run backward 100 kw-hours the reading would be 9900. This, added to the reading of the polyphase meter which has recorded an excess of 100 kw-hours, would introduce an error of 10,000 kw-hours.

Blackfoot, Idaho. JAMES B. BROKAW.

CONNECTING TRANSFORMERS IN SERIES.

The plant considered is one of about 1000 hp, and is owned by a municipality. It is used for supplying water and light to a city of about 50,000 population. A mistake was made when the plant was installed in that instead of installing standard equipment generators of 4400 volts were installed. Therefore, when transformers or other apparatus are required to be used in connection therewith, it almost invariably happens that it is necessary to wait until these can be got out on special order and at extra cost.

Recently it happened that a new motor-driven pump was placed in service, and in order to hasten the installation it was decided to use four 1100-2200 primary and 110-220 secondary transformers instead of two 4400 primary and 220 secondary. It was, of course, necessary to connect these transformers with the primaries in series and the secondaries in series-parallel, as shown in Fig. 2.

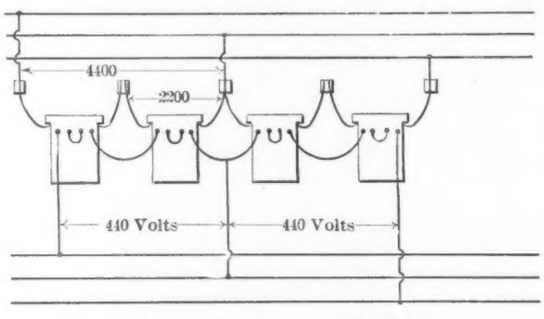


Fig. 1—Original Connection of Transformers.

The electrician happens to be a machinist and a good one, but a very poor electrician. He depends upon his subordinates to hold his position for him and makes no effort to learn for himself. He is usually "awful" busy about the time that work of this kind is to be done and thus endeavors

to conceal his ignorance. It happened in this case that my own work depended upon his work being done, and I had to stand idly by and wait or get into it myself. After the assistants of the city electrician had spent the greater part of two days trying to get the transformer connections right, I suggested the method shown, with satisfactory results.

Before I took the matter in hand the connections had

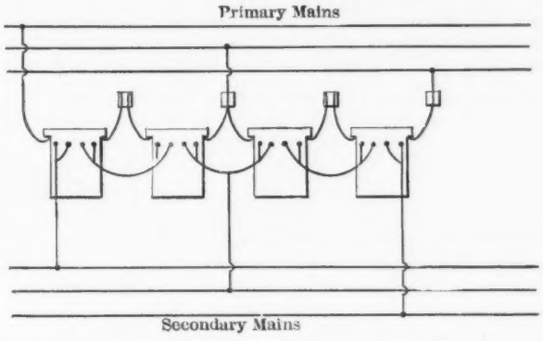


Fig. 2—Corrected Connections of Transformers.

been made as shown in Fig. 1, which would, as will be readily seen by those familiar with this work, give 440 volts at the secondary. The reason for this will be clear, since in this form of connection the secondaries of each transformer are connected in series, which would give 220 for each transformer, and then it will be further noticed that the transformers are connected in series, so that this 220 is doubled, therefore giving 440 volts secondary on the line.

While this method of connecting transformers is one that may be commonly met with, and in any event is not one that should trouble the expert accustomed to this class of work, it is not so common in the smaller cities as to enable the ordinary worker to become familiar with it. Therefore I have thought that it might be worth while to give this explanation together with the diagrams.

I will add in this connection that every man engaged in engineering work, in whatever line, should keep a scrap-book in which matter of this kind should be filed. Better yet if the periodical literature is bound and indexed so that the articles of interest can be quickly found.

To indicate the value of this I will mention that in the days when we were undergoing the transition from 1000 volts primary to 2000 and 2200 volts we met with these conditions frequently, and it was from an old sketch which I have had filed away for fifteen years that I obtained the solution of the matter for the electrician's assistance. Inasmuch as 2200 volts has become the commercial standard, these conditions are seldom met with these days, and hence the ignorance of the ordinary electrical worker in regard to them.

Lincoln, Neb. WILLIAM WESTERFIELD.

BREAKING WATER-GAGE GLASSES.

Water-gage glasses frequently break in a very strange, unexplained manner, seemingly without cause. One fireman under the direction of the writer had a very bad record for breaking glasses. Hardly a day passed without one or more glasses being broken. Finally the writer, having kept a close watch upon the movements of the fireman, found that the glasses were broken by too frequent and too prolonged blowing out of the water column. A dozen times a day the fireman would open wide the drip at the bottom of the column and let the steam and water rush forth at the full capacity of the ¾-in. valve in the drip pipe. The sudden change of temperature was too much for the water-gage glasses to stand. They simply could not respond quickly enough to the sudden change in the temperature caused by the inrush of hot steam and water from the boiler into the comparatively cold glass; hence they broke. This also explains why a thin glass lasts much longer than a thick one. The thin glass can respond more quickly to expansion.

Cleveland, Ohio. MICHAEL FLANNERY.

THAWING WATER PIPES BY ELECTRICITY.

A question in regard to this subject in the *Electrical World* brought to mind some experiences in that direction by the writer which may be of value to some reader who finds himself "frozen up." Many years ago, while living in the country, the kitchens were all provided with sinks, the waste pipes or sink pipes of which passed through the side of the house and discharged into an open drain. The condition of these pipes on a cold morning when the mercury stood 10 deg. or 20 deg. below freezing can well be imagined, likewise the demand for numerous buckets of hot water for thawing out the frozen pipes. The writer, objecting seriously to the frequent task of thawing out sections of 2-in. lead pipe, hit upon the expedient of permanently placing a small pipe inside the larger one for the introduction of hot water whenever the larger pipe should become frozen up. To this end a bit of very small lead pipe, not over ¼ in. in diameter, was procured and a length sufficient to pass through the waste pipe was cut off and fitted with a little sheet lead funnel, which was soldered to the upper end of the small pipe. The funnel was only about 1 in. in diameter at its largest end and a hole was made by means of which the funnel and its attached pipe were hung upon a small nail above the sink. The lower or outer end of the small pipe was bent upward in such a manner that water coming out of the larger pipe could not drip off the end of the smaller pipe, thereby causing it to freeze over at its discharge end and preventing the discharge of the hot water from it. Thereafter when the sink pipe froze solid the women poured a little hot water in the small pipe and then poured more hot water in the hole around the small pipe, which quickly reached the surrounding ice. The writer has many times applied this plan to larger pipes in the several engineering projects with which he has been connected. Small pipes were passed through the large ones, and provision was made so that steam could be passed through the smaller pipes whenever the larger ones chanced to freeze up. The scheme worked very well, except that it was found necessary so to locate the small pipes that they would always drain themselves of whatever water of condensation there chanced to be in them. Recently a case of frozen underground drain came up. The drain not being deep enough in the ground to prevent occasional freezing and the environment preventing the setting of the drain any deeper, the expedient was tried of passing a couple of insulated wires through the pipe and permitting them to remain there permanently. The wires were simply passed through the small pipe, which was made of iron instead of lead. When trouble was experienced by the freezing of the drain electricity would be turned into the wires inside the small pipe until the latter became warm to the hand along a portion outside the drain pipe. As soon as the inclosing pipe felt warm it was assumed that a small hole was melted around the pipe through the frozen section and hot water was turned into the drain, with the result of quickly clearing the conduit of all ice and frost. To save energy the carrying capacity of the inclosed wires was carefully ascertained, and by means of a couple of switches energy from a power machine was turned into the "thaw wires" in such a manner that the wires in question were made a portion of the main circuit during the time the current was passing. The only loss of current was then the amount of energy consumed in heating the conductor and melting the ice.

Akron, Ohio. JAMES FRANCIS.

Questions and Answers

Can you advise me where I can secure information on the Rosenberg generator? The data given by the manufacturer are quite incomplete. Can you also refer me to any information on a method of reducing tungsten to a metallic form as employed in wire-drawn filaments?

L. D. B.

The Rosenberg generator was fully described in an article by Dr. E. Rosenberg which appeared in our issue of Nov. 10, 1906. A method for reducing tungsten to the metallic form employed in drawn-wire filaments, as patented by Dr. W. D. Coolidge, of the Research Library of the General Electric Company, was described in the December, 1911, issue.

Two batteries of different voltages and resistances are connected in parallel to supply current to two parallel-connected resistors of different resistance. One battery has an emf of 10 volts and a resistance of 5 ohms; the other battery has an emf of 2 volts and a resistance of 2 ohms; the resistance of one resistor is 5 ohms and that of the other 10 ohms. What current is produced in each battery and resistor circuit?

E. R.

The problem can best be solved by algebra, the common emf at the terminals of the four parallel circuits being equated to the product of the resistance and current in each resistor circuit and the similar product plus or minus the battery voltage in the other two circuits. The common circuit emf will be found to be 3 volts. The current in the 10-volt battery circuit is, therefore, + 1.4 amp, that in the 2-volt battery circuit — 0.5 amp, that in the 5-ohm resistor circuit 0.6 amp and that in the 10-ohm resistor circuit 0.3 amp.

Has there ever been constructed a direct-current motor or generator without commutator or slip-rings, comprising an ordinary stationary Gramme ring inside of which is a revolving multipolar field, the latter receiving excitation energy from a small Gramme ring mounted on the same shaft near the field and revolving inside of a bipolar stationary field? The revolving field would receive energy from the exciter so as to produce north and south poles at opposite sides with respect to the stationary Gramme ring, thereby producing direct current in the stationary ring winding if the machine is run as a generator, and delivering power if the stationary ring is supplied with direct current.

O. H.

So far as our recollection goes, no direct-current generator having a multipolar field has ever been operated successfully without a commutator. The only commutatorless direct-current generators that have ever proved operative are of the bipolar type. The exciting arrangement described in your letter would probably operate correctly, but the main generator, which you describe as having the multipolar field structure, could not possibly produce an unidirectional emf.

I would appreciate information as to the best practice in fusing induction motors. As the starting current of these motors is much in excess of the running or full-load current, I would like to know what factor is allowed in the fuses for motors that are frequently started and stopped, as in hoisting service. What injury would be done these motors if they were not fused at all? If the main switchboard circuit-breaker would take care of short-circuits, would not this afford sufficient protection?

F. F. S.

It is not wise to leave an induction motor unprotected with fuses or circuit-breakers. However, it is not unusual to omit the fuses (which protect a motor under normal running conditions) during the short time when the motor is being brought up to full speed. This method is permissible in view of the fact that during the starting period the motor is under the direct supervision of the man who is starting the machinery and any trouble which might develop at this time would be immediately detected. According to one method use is made of the equivalent of a throw-over switch, so that the protecting fuses are either not in circuit during the starting period or are short-circuited at this time. However, they are left permanently in circuit during the normal running of the motor.

A machine when operated as a motor possesses the following characteristics: Approximate rating 2 hp, volts 24, amp 70, speed 1200 r.p.m. If the machine were run as a generator would the following hold true: Approximate rating 1 kw, volts 6, amp 17½, speed 300 r.p.m ? The machine is to form part of a self-starting outfit for an automobile, and is to be driven by the engine and storage batteries. When the engine is running the machine will operate as a shunt dynamo, supplying energy for ignition and lighting, and also for charging the batteries, which will consist of four individual batteries of 6 volts each connected in parallel. When the engine is to be started the battery, connected in series, discharges through the machine, which, acting as a compound motor, runs at 1200 r.p.m. and turns the engine by a mechanism at 60 r.p.m. until ignition begins. Then the mechanism releases the motor, which is then driven by the engine as a generator at half engine speed. Several automatic cutouts are used for closing the circuit when the battery is charged and for throwing the generator out of circuit at high and low speeds. Would a motor speed of 2400 r.p.m. and a generator speed of 600 r.p.m. be preferable? The engine speed varies from 300 r.p.m. to 1800 r.p.m. Between what ranges of speed should the generator remain connected with the battery circuit?

W. F. C.

Assuming that the machine mentioned is properly built for operating at 24 volts and 70 amp when used as a motor at 1200 r.p.m., it is permissible to use the machine as a generator for producing 6 volts when driven at a speed of 300 r.p.m. Just why you have assigned a current of 17½ amp when the machine is run as a generator we do not understand. It would seem that it should deliver 70 amp without overheating. With 70 amp and 6 volts the output should be 0.42 kw. If this machine is to be run at speeds varying from 300 to 1800 r.p.m. it will be absolutely necessary to employ some automatic device for maintaining the current within the proper range. Several schemes have been developed and patented for this purpose, but your attention should be called to the fact that the problem is no simple one.

Given the equation of the impressed emf on the primary of an iron-core transformer, the necessary constants of the circuits, etc., what equation will give the absolute values of the flux in the core and the currents in the primary and secondary circuits?

R. O. H.

It is impossible to give any equation for representing the flux in a transformer which is not based upon the impressed emf rather than on the primary or secondary current. The flux in the transformer depends solely on the primary emf and number of turns. There is no relation whatsoever between the flux and the secondary current. A certain component of the primary current depends upon the flux, but not the flux upon it, so that an equation can be formed between the core flux and this one insignificant component of the primary current. These are facts which nature has presented to us and mathematical representation cannot change them. The relation between the maximum value of the flux in lines in a transformer φ_m, the frequency f in cycles per second, the number of turns N, and the emf E in volts is expressed by the following fundamental equation:

$$\varphi_m = \frac{100{,}000{,}000\, E}{4.44\, f\, N}$$

The secondary current depends solely on the ratio between the secondary emf and the total impedance of the secondary circuit. The secondary internal emf bears the ratio of turns to the primary internal emf and is independent in every respect of the primary current, flux in the transformer, reluctance of the core or anything else that we can think of. The primary current consists of two components, a small component necessary to produce the required amount of flux which the primary emf demands, and superimposed upon this current is another current, which is equal to the second current divided by the ratio of turns. These facts also are laws of nature and cannot be changed by mathematical representation. They are discussed in almost all textbooks on electromagnetism.

Central Station
Management, Policies and Commercial Methods

BUSINESS-GETTING IN LOUISVILLE, KY.

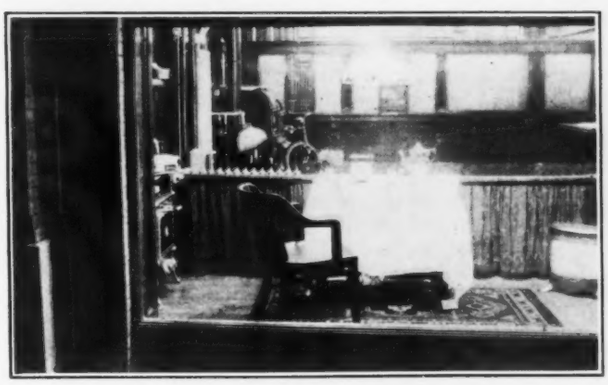
The report of the new-business department of the Louisville Lighting Company, of Louisville, Ky., for the months of November and December, 1911, indicates that there has been an increase in business of 100 per cent for those months as compared with the corresponding period the previous year. The increase is attributable solely to the business-getting campaign recently instituted by the Louisville company, and is stated not to proceed in any way from newspaper advertising, being directly traceable to demonstration work and other direct methods of the company.

THE POWER WASTE IN SHAFT DRIVE.

In computing the power requirements for a plant about to be converted from mechanical or shaft drive to central-station operation with individual motors the solicitor must be guarded against overestimating the probable consumption of kw-hours based simply on the former rated engine horse-power. The experience of one power expert who has indicated a number of such drives shows that usually not less than 40 per cent of the power developed is wasted in the line shafts, while another 10 per cent is lost in the engine itself. The noon hour is a good time to compare the useful power requirements with the loss sustained in friction in the belts and shafting. By running the plant idle and measuring the power consumed at this time some surprising intelligence can often be obtained for the owner. In the average case, as already noted, the electrical horse-power requirements of individual drive will be only about 60 per cent of the former mechanical rating.

CENTRAL-STATION SHOW WINDOW.

The household conveniences and comforts of electricity are well demonstrated in the window displays recently made by the Oregon Power Company at its Eugene (Ore.) office. Mr. G. N. Rooker, the local contract agent, arranged one window as an electrically equipped dining-room, as



Central-Station Show Window.

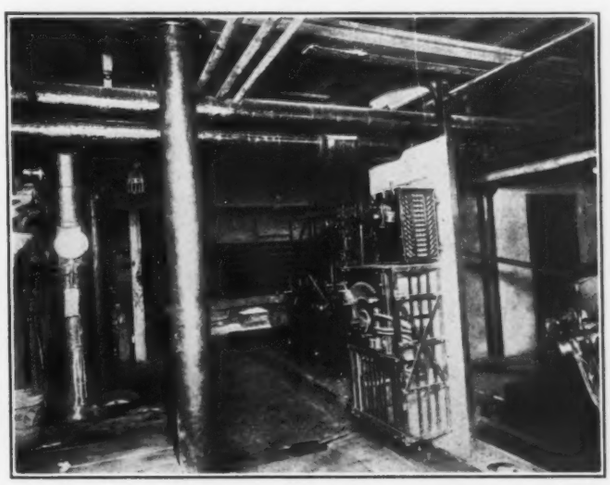
shown in the accompanying illustration. At the right is a three-unit luminous radiator. The table, lighted from an attractive electric dome, carries an electric percolator and toaster, and at the left is seen an electric range ready for cooking.

COST OF OPERATING HORSE-DRAWN AND ELECTRIC MOTOR TRUCKS.

According to the testimony of large business houses, it costs from $6 to $6.50 a day to keep a wagon and team of horses at work, but the motor truck does the work of three such outfits and effects a saving in operation of 33⅓ per cent. A recent estimate of cost of operating electric trucks showed that the fixed charges on a delivery wagon amount to $303 a year for interest and depreciation on non-wearing parts, maintenance for maximum service to $389.50 a year, and garaging, including charging energy, to $108. This amounts to $800.50 a year, or $2.66 per working day, not including drivers' wages. At $15 a week, wages would bring the total daily cost to $5.16. On the same basis the total cost of running a light truck is $5.63 a day and that of running a heavy truck $6.91 a day. Larger and heavier makes of electric trucks cost from $7 to $8 a day to operate.

A NORTH DAKOTA MOTOR-DRIVEN COLD-STORAGE PLANT.

In the neighborhood of Fargo, N. D., the natural ice crop, as might be expected, never fails, and the cost of the natural product is probably as low there as in any United States city, except perhaps Nome or Juneau, Alaska. Even with such cheap ice, local cold-storage plants find it advantageous to use artificial refrigeration, and the accompanying photograph shows the motor-driven refrigerating equipment of Eggert's sanitary market at Fargo. The motor equipment comprises a 35-hp, 220-volt direct-current motor driving a 12½-ton Vilter ammonia compressor. The brine pump for circulating the refrigerated fluid through the cold-storage pipes is also operated by a 3-hp motor. This installation averages a consumption of about 1000 kw-hours a month and secures for its owner all the numerous advantages over natural icing, which include lower tem-

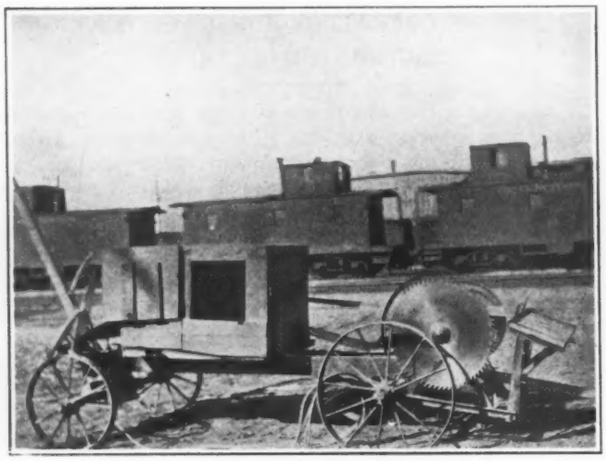


A Motor-Driven Cold-Storage Plant.

peratures, dry quality of cold, saving of meat trimming, reliability of operation, and freedom from the annoyance and muss of ordinary ice-boxes. Central-station service to operate this installation is obtained from the lines of the Consumers' Power Company.

A FARMER'S MOTOR-DRIVEN SAW.

The circular saw shown herewith is driven by a 5-hp direct-current motor inclosed in the boxlike housing at the left. This portable set is arranged with 100 ft. of flexible



Motor-Driven Saw.

conductor ending in a contact plug for attachment to any of three outlet blocks mounted on buildings about the yard. Formerly a gasoline engine was employed for this work, but it proved unsatisfactory. The motor was then purchased, lines were run to the farm, and the truck was constructed as shown. The housing is roofed with tar paper, and the motor shafts and pulley extend out through the wall on the side opposite to the observer. A narrow belt is used to drive the shaft of the circular saw. The steel framing at the right provides a table shelf on which to rest stock while sawing. The same motor can also be used to drive a grain elevator.

ELECTRICITY IN A WOODYARD.

The Fairchilds Fuel Company, of Grand Forks, S. D., formerly used a gasoline engine for operating its saws and wood chopper. These services have now been converted to motor drive, greatly to the convenience and economy of the customer. Fig. 1 shows the Fairchild portable saw and the method of plugging its cable into contact blocks located on poles about the woodyard. The saw is driven by a 3-hp

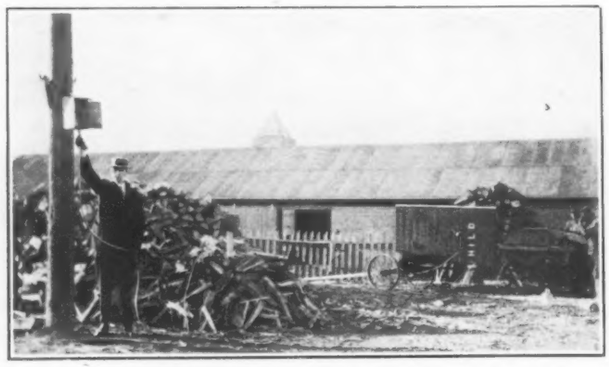


Fig. 1—3-hp Direct-Current Motor and Portable Saw.

direct-current motor and can be easily moved from place to place in the yard where wood is to be cut into stove lengths. One hundred feet of flexible armored cable connects the saw motor with the contact plug. Fig. 2 shows a 2-hp motor mounted on a portable skid and driving the wood chopper or splitter. This motor housing on its large timbers, carrying the chopper frame also, can be skidded around the yard. As shown in the illustration, a small belt drives the chopper, which consists simply of a large belt-wheel and pitman arm, the reciprocating element

Fig. 2—2-hp Direct-Current Motor on Portable Skid Driving Wood Chopper.

of which, moving in guides, carries the splitting wedge. The bottom rest for the wood is adjustable for different lengths.

CENTRAL-STATION LOAD FACTORS.

Desirability of Railway, Ice-Making and Other Loads to Utilize the Generating Equipment and the Economic Advantages of a Single Generating System for All Purposes.

By E. F. Tweedy.

The term "load factor," as it is used in connection with the generation of electrical energy, has been employed in a number of different senses. Load factor in the sense in which it is most commonly used may be defined as the average load upon a station throughout the year expressed as a percentage of the maximum observed load upon the station during the same period. Sometimes the term "plant load factor" is used to express the ratio of the average load upon the generators during the year to the aggregate rated generating capacity, including spare units, while the term "station load factor" is taken to mean the ratio of the average load on the station feeders during the year to the maximum observed load upon these feeders. Again, load factor is sometimes given quite a different meaning and is defined as the ratio of the average load, as represented by the electrical energy actually sold to the consumers, to the maximum load supplied to the feeders at the station, expressed as a percentage. As thus defined, the load factor could never reach 100 per cent, even if each consumer were to use his entire installation twenty-four hours a day throughout the year, for the reason that the average load, which would be equivalent to the total kw-hours sold during the year divided by 8760, would always be less than the load upon the feeders on account of the losses occurring in transmission and distribution.

The load factor of a generating plant—not necessarily the plant of a central station—is frequently based upon a time interval of twenty-four hours, the load factor over a given period being defined as the ratio of the average twenty-four-hour load upon the generators to the rated capacity of the generating units, expressed in the form of a percentage, the term "true load factor" being then used to express the ratio of the average twenty-four-hour load to the maximum load, likewise in the form of a percentage. An additional term, designated as "loading factor," is sometimes employed to express the ratio of the average load car-

ried by a single generator or by several generators throughout a period of twenty-four hours to the continuous rated capacity of such generator or generators, this also being usually expressed in the form of a percentage.

The definition of load factor first given, which is the

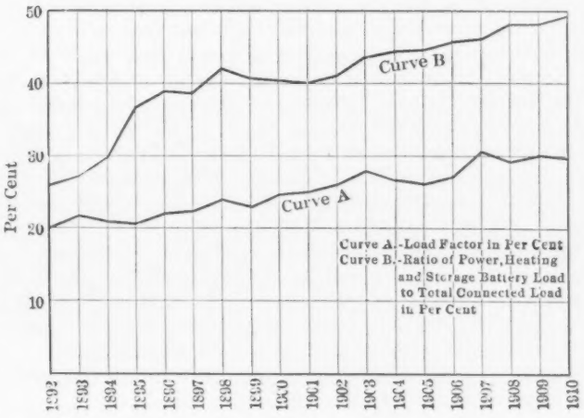


Fig. 1—Load-Factor Curve of Station for Nineteen Years.

one that is most generally used, is susceptible of two slightly different interpretations, but the differences which they involve are usually of very small consequence. The average load on a station may be taken to mean the average load upon the generators or the average load upon the feeders, while the maximum load may, in a similar manner, be considered as referring to the maximum load upon the generators or to the maximum load upon the feeders. The difference between these two sets of measurements represents, of course, the amount of electrical energy used within the station itself, plus any losses that may occur between the two points of measurement. As the amount of electrical energy that is used within the station is usually an exceedingly small percentage of the amount sent out over the feeders, little confusion is likely to result from the very slight amount of uncertainty that is involved in the use of this definition of load factor.

The accompanying table gives the load factors of a number of central stations located in this country, the majority of the figures being for the year 1910. The load factor as given is the ratio of the total kw-hour output for the year to the maximum demand in kilowatts multiplied by 8760 hours, expressed as a percentage, this being, of course, the same quantity as the ratio of the average load during the year to the maximum load, expressed as a percentage.

Curve A, Fig. 1, shows the increase in load factor on the low-tension direct-current network of a large central station from 1892 to 1910 inclusive, a period of almost twenty years. It will be seen that the load factor has increased during this period from 20 per cent to approximately 30 per cent, a figure which still leaves much to be desired. As this increase in load factor has resulted almost entirely from an increase in the use of electrical energy for purposes other than lighting, it is of interest to observe the increase during the same period of the percentage relation which the connected load in motors, heating devices, storage batteries, etc., bears to the total load connected to the system. This is shown by curve B. The actual increase has doubtless been somewhat greater than is disclosed by this curve for the reason that many electric-heating appliances and similar devices have undoubtedly been connected during the past few years without any opportunity being afforded the central station of noting them upon its records. It is also reasonable to assume that there have been many cases where tungsten or other of the higher efficiency lamps have been substituted for carbon-filament lamps of higher wattage without the central station being able to record such substitution. However, as the records of this central station have been very carefully kept, it may be assumed that curve B very closely represents the actual conditions as regards connected load over the period selected. It is of interest to note that the portion of the connected load other than lighting has increased

YEARLY OUTPUT, MAXIMUM DEMAND AND LOAD FACTOR OF CENTRAL STATIONS.

Station.	Yearly Output, Kw.-hours.	Maximum Demand, Kilowatts.	Load Factor, per Cent.
A	878,140	847	20.5
B	1,481,000	555	30.5
C	2,625,937	1,550	19.3
D	3,238,766	1,700	21.7
E	3,288,623	1,210	31.0
F	3,721,153	1,675	25.4
G	4,408,965	1,950	25.8
H	4,462,550	1,625	31.3
I	4,715,000	1,650	32.6
J	5,858,255	2,510	26.6
K	5,960,000	2,760	24.6
L	8,789,195	3,175	31.6
M	8,800,828	3,350	30.0
N	8,904,300	2,900	35.1
O	10,185,832	4,330	26.9
P	11,100,000	4,700	26.9
Q	15,540,035	5,270	33.7
R	16,500,000	9,800	19.2
S	16,930,345	6,000	32.2
T	19,037,529	7,725	28.2
U	22,179,000	10,348	24.5
V	23,053,128	7,700	34.2
W	25,297,757	12,325	23.4
X	32,773,730	10,260	36.5
		Average	28.0

from approximately 26 per cent of the total connected load in 1892 to nearly 50 per cent in 1910.

The introduction of the higher efficiency lamps should naturally tend, provided other conditions remained the same, to reduce the percentage which the connected lighting load bears to the total connected load, and as a consequence some betterment in the load factor should result. The adoption of these higher efficiency lamps, however, has disclosed the fact that other factors now enter to modify the conditions that existed prior to the advent of these lamps. For instance, up to the present time many central stations have experienced little or no loss in their rate of increase in connected load due to the introduction of these lamps, partly as a result of being able to secure enough additional business—due to the lessened cost of electric light—to offset the reduction in the load that might otherwise have resulted, and also partly because the higher efficiency lamps have in some degree resulted in an advanced standard of lighting, the consumer taking a portion of the gain due to the improved efficiency in the form of more illumination, rather than taking it all in the form of a reduction in the connected load and in the amount of electrical energy consumed. Under such conditions as these the introduction of the higher efficiency lamps has little or no effect upon the ratio which the connected lighting load bears to the total connected load. Curve B would seem to show that in the case of the central station under consideration the effects of the introduction of the higher efficiency lamps have been fully offset by one, or by a combination of both, of the factors above mentioned. Whether such a condition will continue depends upon whether the increase in the number of lighting customers is sufficiently great to offset the lower connected lighting installation per customer. If the number of new users is not sufficiently great to overcome the reduction in the lighting installations of existing customers, curve B will naturally tend to rise more rapidly than it would if governed solely by the gradual increase in the percentage relation which that portion of the connected load other than lighting bears to the total connected load.

Aside from this question, however, it would appear that the higher efficiency lamps should have an appreciable effect upon the load factors of central stations. The lessened cost of electric light that has resulted from the introduction of these lamps is almost certain to bring about a more extended use of electricity; that is, not alone an increase in the number of users—a result that is already apparent—but an increase in the number of hours of daily use of the average lighting installation.

A central station which has secured a considerable amount of railway load reports a load factor of slightly over 41 per cent for the year 1910. The acquisition of railway load by a central station will almost invariably result in an increase in the load factor. The load factor of the average central station is probably slightly below 30 per cent, while the load factor of the average electric railway is usually some 40 per cent or over. The railway "peak" rarely, if ever, coincides with the central-station lighting "peak," as a result of which the load factor of the central station is benefited by the railway load to a greater extent than it would be by the acquisition of a load of equally high load factor but with a maximum demand coincident with that of the central station.

By means of Fig. 2 it is possible to compare the variations in the demand for transportation throughout the

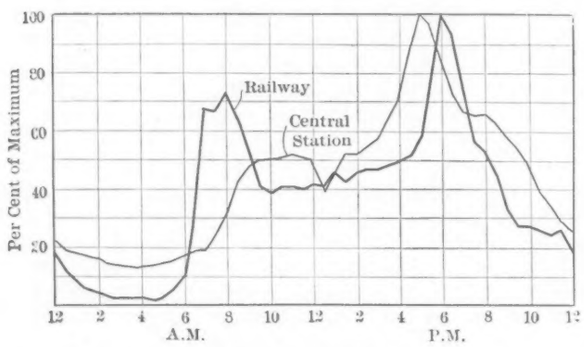


Fig. 2—Comparison of Railway and Central-Station Load Curves.

twenty-four hours of a working day, under the conditions existing in New York City, with the variation in demand for electrical energy, as represented by the output of the central station over a characteristic twenty-four-hour period taken in the month of December at about the time of the maximum yearly load. The transportation load curve, which is shown by heavy lines, is based upon observations made by the Public Service Commission, and it shows the volume of the traffic upon the surface lines in New York City at half-hourly intervals throughout the twenty-four hours of an ordinary business day, the total traffic existing at the time of the observed "peak" being taken as 100 per cent. The half-hourly loads upon the central station are likewise expressed in percentages of the maximum load throughout the twenty-four hours. It will be observed that the transportation "peak" occurs at 6 p. m., which is one hour later than the time of the central-station "peak." The twenty-four-hour transportation load factor is found to be approximately 38 per cent, but the yearly transportation load factor would be practically the same, inasmuch as the transportation requirements—except in so far as they are affected by the natural growth in traffic—remain practically constant throughout the year. The central station load factor for the day shown was 43.7 per cent, but the yearly load factor, based upon the maximum yearly load, was a trifle under 30 per cent. A generating station supplying electrical energy for these transportation requirements would have a load factor considerably higher than that shown by the transportation load curve, for the reason that the power demands of an electric railway do not vary to such an extent as does the volume of traffic that is being handled, due to the fact that the bulk of the power is required for moving the cars themselves and is therefore independent of the amount of live load that is being carried, and to the further fact that the number of cars in service is not varied in direct proportion to the variations in the total passenger traffic.

However, this matter of the desirability of securing railway load is now very generally recognized by central-station managers. The argument that a manufacturer should devote his undivided attention to the manufacture of his final product and not dissipate his energies by undertaking the production of the various elements—of which power is usually an important one—that enter into the composition of this product applies with almost equal force to those who are engaged in the business of supplying transportation. Central stations should control the entire field of power generation within their respective territories, and such an achievement will undoubtedly be brought about eventually when the advantages that result from specialization and concentration in this field have been fully realized.

However, if central stations are to obtain higher load factors than those afforded by the entire light and power requirements of the communities which they serve, special kinds of load must be secured to fill in those low portions of the daily and yearly load curves that will otherwise continue to exist as a result of the unavoidable variations in the demand for electrical energy throughout each twenty-four hours and throughout the year. It is unnecessary to say that no one kind of load has as yet been found that fulfils all of the requirements of this "filling-in" process, although several have been tried that meet some of the requirements in a more or less satisfactory manner. Probably the most successful of these up to the present time is to be found in the manufacture of ice in conjunction with the generation of electrical energy.

This question of finding a satisfactory form of "off-peak" load is of tremendous importance to the central-station industry, and it well warrants the vast amount of thought that is being expended upon it by those engaged in central-station work. To give some idea of the economic loss that is now occasioned by the poor utilization of the electrical generating equipment in the central stations of this country it is only necessary to refer to the report of the Bureau of the Census for the years 1902 and 1907. In 1902 the total generating equipment of the central stations of this country was stated as being 1,212,235 kw and the yearly output in kw-hours 2,507,051,115. These figures show that this total generating equipment was utilized at its rated capacity only during a little over 23 per cent of the entire year. In 1909 the generating equipment had increased to 2,709,225 kw, while the kw-hour output had increased to 5,862,276,737. These latter figures show that the entire rated generating capacity was in use during only slightly over 24 per cent of the entire year. It was recently stated that 97 per cent of the total kw-hours generated by a large central station was produced by 50 per cent of the total generating apparatus installed, the other 3 per cent being generated by the remaining 50 per cent of the generating capacity. As a result of this 50 per cent of the generating equipment is being operated at a little under 50 per cent load factor, while the yearly load factor of the rest of the generating equipment is only some 5 or 6 per cent.

Wisconsin Public Service Commission Orders Increase of Rates.

As noted elsewhere under the head of Public Service Commission News, the Wisconsin Commission has ordered a central-station company to increase its rates, partly on the ground that they are so low as hardly to cover operating expenses.

LOW RATES AND THE DEVELOPMENT OF THE CENTRAL-STATION SERVICE.

A Suggested Schedule Involving Central-Station Control of Customers' Meters, Transferring Them to a Higher Rate Only at Times of Extraordinary Peak Loads.

BY W. E. BURNAND.

Three significant facts stand out in connection with modern central-station electrical systems:

(1) Much of the costly generating and distributing equipment is idle most of the time.

(2) During all this idle period energy could be generated at an extremely low rate.

(3) There is an enormous and rapidly extending field open for such cheap energy if available.

From the foregoing it is evident that there exists not only a great demand, but also the capability for supplying that demand, to the mutual profit of both consumer and central station.

No other single thing, in the opinion of the writer, could have such a beneficial effect on the electrical industry at present as a radical reduction in the price of electrical energy. That this is possible is suggested from a consideration of the facts above set forth. The extent of the field available may be questioned, but to the writer it seems that the present case is analogous to the state of the motor-car business in the days of its red-flag and 4-mile-an-hour limitations. As the motor-car business was stagnant under early restrictions, so a large part of the electrical business is stagnant under unsuitable charging rules and will remain stagnant until these restrictions are removed.

But with energy available at, say, 1 cent per kw-hour at every point of a central-station system, the development in the use and manufacture of energy-consuming devices would probably be as remarkable as that of the motor-car industry. As a rough all-round figure it is probable that 1 cent per kw-hour, as suggested, would be a profitable rate for the companies on all the extra energy they could supply with their present equipment beyond what they are now producing, if, of course, this extra output involved no considerable extra outlay. A suitable system of charging should therefore render this cheap but profitable energy readily available.

Electrical service, it is recognized, means more than simply the supply of a certain number of units of electrical energy, and its cost is by no means in proportion to the number of kilowatt-hours supplied. But the outstanding feature of most rate systems is that they are restrictive, in most cases with comparatively little advantage to the central-station company. To tax the consumer on every outlet at which he can use energy does not appear to be good business logic, for, surely, every such outlet is a convenience to the consumer and a source of profit to the central station. The ideal system, therefore, would be one where connection could be made to any and every possible portion of the customer's building, so that energy could be used at every opportunity. Nor does it appear advisable to tax the consumer on his periodical maximum demand, for, as a matter of fact, the oftener the demand approaches the maximum the better, the only objection being when this occurs at the peaks of the specially heavy days.

These systems, of course, have been designed with the object of keeping down the peak, but it is to be feared that they also keep down the lower parts of the supply curves by tending to develop habits of undue economy. For it cannot be denied that for each time the peak penalty arrangement is of value to the company it is fifty times a direct disadvantage. The only occasion when there is any reason for restricting the use of energy is when the system is loaded up to its safe capacity, which is comparatively seldom.

Before going further it will be well to realize how few hours there are in the whole year during which the peak becomes a danger, although the cost of coping with it is one of the chief bugbears of the central-station business.

Taking a few typical load curves for different periods of the year, it will be noticed that there are usually two per diem. The smaller of these peaks may be entirely ignored as it is only the very highest that are of significance in the present discussion. The highest peaks of all often occur in the daytime, where ordinarily the curve is only normal. Such peaks are occasioned by superimposed lighting demands, due to dense fogs, clouds and storms occurring at times when the motor load is also heavy. It is these contingencies which are really the most trying, and it is these which call for a central-station capacity so much larger than otherwise needed. But consideration will show that it is right here most rate systems fail of their desired effect, since they do not apply at the times when the ordinary load and the extraordinary load overlap.

This brings up the question as to whether it is not advisable to work directly on the matter of the maximum peak demand, arranging to charge the consumer at a higher rate only at the particular periods when this demand approaches the safe limit of the central-station equipment, irrespective of time or character of service, although making in addition a charge to cover the capital outlay on the distributing plant. Such a system would not be difficult for the customer to understand, if its terms were suitably explained to him. While such a proposal may require some little effort to accustom one's self to its unusual provisions, the advantages it offers appear to render it well worth considering.

To keep down the normal peak is to lose good revenue without advantage, since the plant is already available for energy supply. But it is the *abnormal* peak that costs so heavily in plant investment. From the central-station engineer's standpoint it is obvious that, if this maximum peak can be kept down and the valleys raised to somewhere near the value of the normal peak, the greater the consumer's maximum demand becomes the more effective also becomes the means of raising his maximum demand and total energy consumption.

All this, of course, is to the advantage of the central station and to be desired, and every encouragement should be given to the consumer, no restrictions being put on his use except during the few hours a year when the total maximum demand approaches the safe limit of the plant capacity.

The system which the author has to propose involves a two-rate meter which will ordinarily register at a low rate, excepting at the particular periods when the demand on the plant becomes excessive, when the meter can be transferred to register on the higher rate. An indicator showing when the high rate is in force, informing the consumer when he is being charged at the increased rate and thus helping to keep down the high peak on the plant, would be very desirable. The change from the low to the high rate should preferably be made automatically. At the moment, the requisite automatic arrangement does not appear to be commercially available, although no doubt it would soon be produced should any active demand for it arise. At the start, therefore, the change from one to the other rate would have to be made from the central station by some means of remote control.

The condition for applying the high rate would then be set in accordance with a fixed ratio of load to plant rating for the few occasions at which it would be required, since, as already pointed out, the desire is not to reduce the normal peaks but only the abnormal peaks, incidentally raising up the rest of the demand to the normal peak level.

Particular emphasis should be laid on this point that the high rate is not chiefly for the purpose of obtaining revenue, but for bringing the abnormal peaks under control, thus enabling a given plant to furnish safely a much greater output than would otherwise be safe. As the connected load on the plant increases, the high rate automatically comes into force oftener, tending to restrict the demand slightly. Then when the plant is extended this restriction is automatically removed, and the demand goes up rapidly, so that the new plant soon earns its proportion of revenue.

The advantages likely to accrue from the suggested rate scheme are, briefly, that it automatically differentiates between different classes of consumers, minimizes clerical work and risk of errors, does away with duplicate wiring and meters, and requires no inquisitive restrictions as to the purpose for which energy is being used, whether for heating, motors or lighting. It also avoids periodical inspection of the number of the customer's outlets, the type and candle-power of his lamps, and places no limitation beyond fuse capacity to the demand which the consumer may take. But, above all else, its greatest inducement is the low rate it charges for energy at all times except during a few hours each year. The use of electricity would thus be encouraged for any and every purpose, without the trouble of extra wiring and separate meters, resulting in the rapid extension of electric cooking and heating and in the increased use of power-consuming devices now held in check by restrictive tariffs and rate systems.

From the central station's standpoint the consumer's bill, instead of containing such varied items as meter rental, energy for lighting, energy for motors and sometimes also energy for heating—all further complicated with quantity discounts, maximum-demand arrangements and sliding scales—would contain only the three items of service charge (covering the interest on the cost of service mains, meter rental, etc.), kilowatt-hours at the low rate, and kilowatt-hours at the high rate.

To place the terms of the proposed schedule before the public, it is suggested that an explanatory circular along the lines of the following be prepared for customers:

CHARGES FOR ELECTRICITY.

The rate for electrical energy under the new schedule is made up of a "service charge" (shown in the schedule below), plus 1 cent per kw-hour for all energy used, except during a few hours each year, when, for instance, it becomes very dark while our biggest motor load is on. At such times, when the demand on the generating station is over the normal, the rate becomes 10 cents per kw-hour extra.

The meters have two dials, one registering the total kilowatt-hours used, the other the kilowatt-hours taken at the higher rate.

Indicators to show the rate that is in force at any time, and which can be placed anywhere on the consumer's circuit, can be purchased at about $2. For 75 cents extra these indicators can be fitted with buzzers to sound when the high rate is in force.

SERVICE CHARGES.

250-Watt Meters.—For houses in blocks, where ground need be opened not more than once for each six houses, to install service, 62 cents monthly, with 7½ kw-hours free.

250-Watt Meters.—Ordinary houses or services, $3.75 per quarter.

500-Watt Meters.—Ordinary houses or services, $5 per quarter.

1000-Watt Meters.—Large houses or services, $5 per quarter for each kilowatt of meter rating nearest standard suitable size.

Where, owing to special circumstances, the cost of service is not normal special rates will be quoted, dependent on the cost of supply.

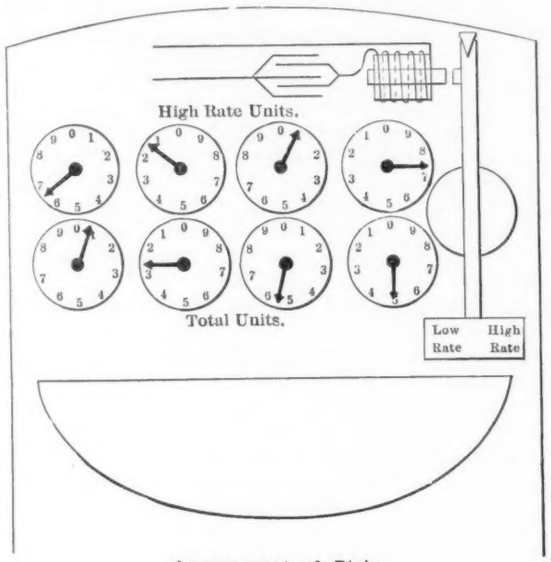
In case of intermittent usage, where service is required only for periods not exceeding five hours per week, the service charge will be one-third the above. For energy taken by motors between the hours of 9 p. m. and 6 a. m., but cut off at other times, the service charge will be one-third of the above rates. Large users will pay the schedule rates above up to 4000-kw hours per year, with a discount of 25 per cent on all units over 4000 per year, plus a further discount of 10 per cent on all units over 100,000 kw-hours per year.

Connections to mains will be made free up to a distance of 60 ft. from existing mains along principal roads, or 20 ft. over private property, but not beyond consumer's boundary wall. Beyond that distance extensions will be charged for, payable either in a single sum or in instalments spread over a period of five years, at a slight increase to cover interest.

For making the change-over from the high to the low rate on such a two-rate meter several methods will at once suggest themselves. A separate control circuit might be installed, the mechanism itself being perhaps of the polarized type. Another arrangement might utilize a small low-voltage current of fairly high frequency superposed on the main supply. The change-over mechanism would be actuated by a small electromagnet of a large number of turns, connected in series with a condenser so as to approximate resonance. Such a device could be made quite small and manufactured in large quantities for a dollar or so apiece.

The arrangement of dials preferred is shown in the accompanying diagram, the low-rate scale being permanently in circuit, while the high-rate is made to register, in addition, at the high-rate periods. The total consumption is thus charged for at the lower rate, to which is added the excess charge of the high-rate unit. Such an arrangement could be readily fitted to existing meters, and offers no possibility of the mechanism sticking half way with neither dial working.

The indicators, which could be fixed anywhere on the consumer's circuit or plugged into any lamp socket, need be only simple electric-bell movements in series with small condensers arranged round the magnet bobbins. If an audible signal is desired, a diaphragm could be placed close to the magnet. The high-frequency control current would



Arrangement of Dials.

be superimposed on the main circuit through a series transformer and would be applicable to either alternating-current or direct-current systems. To keep down the size of the transformer on alternating-current systems it would be so proportioned as to have the iron saturated by the main current at the high parts of the current curves. Thus the superimposed high-frequency current would be only slightly perceptible near the peak of each current wave, but of full force at the lower values of the curve.

To determine the service charge above outlined for different classes of load, one should deduct from the present total revenues under the old schedule (assuming the results are reasonably satisfactory) the low cost per kw-hour it is proposed to charge—say, 1 cent to 2 cents per unit. The balance would then become the service charge.

The price per kw-hour should be fixed very low, as this energy charge is not the total revenue. Adding to it the service charge gives an equivalent rate that is very high where the load factor is bad, but these are just the cases where a high rate can be afforded. With this arrangement a fair minimum revenue is assured, whatever improvements may be effected in lighting appliances, while the door is opened to an increased use of other appliances such that any reduction in consumption for lighting would be swamped by these.

While it is desirable that all classes of business be equally profitable, any system of rates insuring such a result would also in some cases drive away business that, if not itself profitable, might be desirable either as an advertisement or from the possibility of producing profitable business later. The service charge might therefore be made somewhat lower, and the charge per kw-hour somewhat higher than would result from a strict analysis of the costs. The service charge would be based on net fixed costs without profit, while the rate per kw-hour would cover running costs plus a profit. This should represent the chief concession to retain business that would otherwise be lost.

The service charge may be based with advantage on the meter capacity needed. To protect the meter—not to limit the maximum demand—the author would prefer, instead of a fuse, an automatic cut-out with a good time lag, arranged so that it can be reset by the customer, but not held in against an injurious overload. Not having the risk of a serious shutdown, the customer is likely to use energy with greater freedom, and thus to work up to higher loads than otherwise, leading to increased revenue.

The variation noted on the schedule of charges, where not quite self-explanatory, may be further explained thus:

Definite light-load-period business, say from 9 p. m. to 6 a. m., evidently requires little plant equipment to be kept that would not otherwise be utilized. The service charge here can therefore justly be reduced, say to one-half or one-third of the usual load-period values.

Intermittent Use.—Where motors or other loads are obviously used only at odd times, due to diversity factor, the same amount of plant equipment is not required in proportion to connected capacity as for full-hour use. To meet these cases, where, for instance, the load averages five hours or less per week, the service charge can be at a low rate, so as not to lose business that would otherwise become too dear.

Mixed Intermittent and Normal Loads.—With the service charge based on the size of meter required, little meter capacity is required proportionately to the demand or connected capacity for the intermittent load, so that this automatically adjusts the rate for service for this class of customer.

Large Users.—The preceding paragraph applies to large users, but further to meet competition and to allow for the lower cost of collecting such accounts a quantity discount appears desirable.

Small Users.—The initial free kilowatt-hours allowed makes it possible to dispense with a meter in cases where obviously the energy used would not much exceed the free allowance. If this allowance is exceeded the company can install a meter without question, as no charge is made for this.

The arrangement of discounts shown in the schedule is suggested as an improvement over specifying various reductions of rates as certain minima are passed. In this way practically any desired steady decrease in the rate per unit on the total quantity can be arranged, without the sudden changes that occur with the usual schemes. The arrangement also avoids the objection of making a customer pay more for fewer kilowatt-hours near the point of price change than he would have done had he wasted some energy to get past the point of change.

INTER-MACHINE INDEPENDENCE IN THE ELECTRICALLY DRIVEN PLANT.

In the mill or factory driven by electric motors each machine is speeded at its most efficient rate. Almost regardless of the load on it or in any other part of the factory, that machine will continue to turn out its work to its utmost capacity. The difference between isolated-plant and central-station drive in this respect was illustrated recently by the experience of a customer who operates a brick plant winter and summer twenty-four hours a day. The local company had spent a good deal of time convincing him that it could furnish energy cheaper than he could make it at his load-factor of 60 per cent or higher, and the customer finally installed motors in his plant. After the plant had been operating about a month an operative of a brick machine complained that he could not keep up with his machine. The speed of the latter was taken and found to be correct as catalogued. The man was asked why he could not take care of the machine now, since he had served it with the old steam drive when it was nominally speeded the same. He replied that in the old days the machine lagged, due to the slipping of belts and the slowing down of the engine under variable load, so that he had a little time to spare. Now, he said, the machine turned out its rated number of bricks every minute, and he could not keep up.

The same thing is true of many other motor applications. In one test made in a woodworking plant it was found that the slip between the engine and the various machines at different times was costing $12 a day in labor over what it would have cost with the same output and the machinery running at constant speed all the time.

Wiring and Illumination

SUBSTITUTION OF PORCELAIN FOR BRASS-SHELL SOCKETS IN BATHROOMS AND CELLARS.

Danger from shock attending the use of brass-shell lamp sockets in cellars, bathrooms and other places subject to vapor and dampness, while known to men engaged in alternating-current work, is not generally known to the public. It is also seldom that a municipality takes it upon itself to notify users of electricity of the facts in the case and to insist upon the substitution of a porcelain or composition socket for the ordinary brass-shell socket in rooms subject to dampness. According to the report of Mr. J. F. Reardon, city electrician of the city of Denver, Col., his department during the past year sent 13,231 notices to owners and tenants of buildings, notifying them of the danger of brass sockets in bathrooms, kitchens and basements. About 90 per cent of the people notified willingly and cheerfully substituted porcelain sockets for the brass-shell sockets, and the department received many favorable and commendatory reports thanking it for the action taken. Some persons felt that it was an imposition on the part of the city electrician, but after the situation was explained to them and they became enlightened as to the danger they too were willing to make the required changes. Although all of the buildings have not been inspected as yet for this change in sockets, there have been about 53,000 changed thus far, and the city electrician feels that his department has accomplished good results along this line.

PRESERVATION OF PINE AND CEDAR POLES.

In a paper read at the annual meeting of the Wood Preservers' Association in Chicago, Jan. 16-18, Mr. W. R. Wheaton described the experience of the San Joaquin Light & Power Company with wood preservation processes applied to about 600 Western yellow pine poles used in the company's 30-mile transmission line.

The poles were cut in the Sierras above Fresno at an elevation of about 4000 ft. and thoroughly seasoned before treatment. A portion of the poles were given a brush treat-

ment with carbolineum and with creosote, and the remainder were treated in the open tank with creosote, zinc chloride and crude oil. Only the butt was treated. Some of the butts were thoroughly penetrated with creosote and with zinc chloride, the average penetration (at the ground line) being 3 in. The penetration with crude oil averaged about 1.5 in. The crude oil was a heavy oil of asphaltum base supplied from the Kern River fields.

In order to ascertain the comparative life of the wood when treated and untreated, stubs of untreated timber were set along the line about a mile apart. In June, 1910, after having been set for twenty-seven months, the untreated stubs along the line were completely rotten. Of the poles brush-treated with carbolineum and creosote, the conditions were about the same, a large percentage of each showing signs of decay; 27 per cent of the poles that had a brush treatment with creosote showed signs of decay, and 29 per cent of the poles that had brush treatment with carbolineum showed decay; 45 per cent of the poles treated with crude oil were slightly attacked by decay. Of the poles treated with zinc chloride, 28 per cent showed attack by decay. The poles treated with creosote in the open tank (over 50 per cent of the entire line were treated in this way) were all perfectly sound and showed absolutely no signs of decay. The company has also applied the open-tank process for treating the butts of Western red cedar poles. The penetration varies from 0.5 in. to 1 in. with an absorption of from 7 lb. to 9 lb. to the cubic foot. Treated and untreated poles have been set in the ground for four years. The creosoted poles are still perfectly sound while the poles set untreated have decayed through the sap wood and into the heart.

STREET LIGHTING AT ENID, OKLA.

Of interest in connection with the erection of the White Way street illumination at Enid, Okla., was the driving of iron conduit beneath the street intersections to avoid tearing up the paving. Sixty ornamental posts were installed, each carrying two 40-watt and one 60-watt lamp. The city streets are underlaid by a soft soil which made it easy to force the pipe beneath the pavement. The 1¼-in. conduit was first capped to avoid filling with earth and was then forced through the soil by means of a lever-operated jack.

Illumination at Enid, Okla.

By careful aiming it was found possible to direct the pipe so that it would come out within a few inches of the desired position at the next post hole. This expedient saved the cost of trenching and repaving for the "White Way" system. Mr. Lincoln Beerbower is manager of the Enid Electric Company, which is operated by Messrs. H. M. Byllesby & Company, Chicago.

THE GROUNDING OF SECONDARIES.

The arguments that have been urged both for and against the practice of grounding secondary electrical circuits were well presented in a paper by Mr. W. J. Canada, electrical engineer of the Rocky Mountain Fire Underwriters' Association, read at the annual meeting of the Western Association of Electrical Inspectors, in Denver, on Jan. 24.

Conservatism on the part of underwriters toward grounding has been noticeable because of a claim that grounding to protect life might increase the fire hazard. Moreover, some lighting companies have opposed grounding because of supposedly greater predisposition of the grounded system to transformer breakdowns. However, in the Rocky Mountain territory at the present time fifty-five lighting companies ground their secondary circuits as a proved safeguard to both life and property. The author presented data relating to the experiences of eleven of these companies together with eighty-nine other companies scattered throughout the United States and Canada. Of these, ninety-two expressed belief in grounding and eighty-six ground their secondary circuits. Advantages in grounding were reported by sixty-nine, and disadvantages by twelve companies, the total number of advantages mentioned being 171 and disadvantages twenty-one. Reduction in fire hazard was reported by sixty-four, and increase by two; reduction in life hazard by eighty-four and increase by two. Operating conditions were improved in sixty-three cases and made worse in nine. Concerning the several methods of making ground connections, thirty-four companies connect to water mains, fifty-two use driven pipes, six use grounding cones, thirteen use grounding plates and three connect to railway tracks. Seventy-one companies prefer the water-main connection compared with six that prefer other methods.

The opposition to grounding formerly shown by underwriters has disappeared and a decided preference for grounding has taken its place. The legal advantages to service companies from grounding form a powerful argument for its universal adoption. Companies may be placed strongly on the defensive if the neglect of so well supported a safeguard should be found responsible for injuries or fires from high voltage in buildings receiving energy from them.

The thoroughness of the connection to ground is a prime necessity. The circuit to ground should be of such a size as neither to burn loose in case of dead ground on the primary circuit nor to deteriorate from the passage of such amounts of current as may be produced by the blowing of the largest primary fuse. The ground connections should be in such numbers and so installed as to present much less than 1 ohm of resistance. The large proportion of companies using the driven-pipe ground connection would appear to indicate considerable satisfaction with this method if it were not that a majority of these very companies express a decided preference for the connection to water mains. In very wet places the driven-pipe connection provides the necessary high conductance, but in all other cases the water-main connection is without a rival. Only one company of the 100 reporting considers water-main ground connections disadvantageous, trouble being anticipated from a possible exchange of current between the water mains and other ground connections at different potentials. The fears of lighting companies that transformers would suffer more in electrical storms under grounded rather than ungrounded conditions have proved unfounded, experience showing that the troubles are lessened rather than increased.

Individual water companies have objected to ground connections being made to their mains, although the method is recommended by the largest water companies and the best hydraulic engineers. The current in the pipes is weak except under abnormal conditions when the fuses blow.

However, even with considerable alternating current no electrolysis is to be expected. Water-works companies are withdrawing their objections as they become enlightened concerning electrical relations and learn to distinguish between direct and alternating current.

The author drew the following conclusions from his study of the subject:

First—Properly grounded secondaries form a thorough safeguard against the entrance of high voltages from every source on the building wiring.

Second—The prevention of high voltage on the building wiring prevents personal injury, fires, meter troubles, lamp burnouts and usually transformer breakdowns.

Third—Grounding is effective in proportion to its thoroughness.

Fourth—Grounding introduces no known troubles not already existing either in life hazard, fire hazard, prejudice to the building piping systems or operating difficulties, and increases none.

Fifth—Thorough grounding entails numerous good, easily inspected grounds close to the buildings to be protected.

Sixth—Grounding emphasizes the value of solid neutrals in interior conduit wiring.

Seventh—Grounding should not be prohibited by National Electric Code rule because of the very slight current through the ground connections.

Eighth—Grounding is equally desirable for protection against undesigned voltages on the secondaries of circuits operating at all voltages.

Letters to the Editor.

REGISTERING MAXIMUM DEMAND.

To the Editor of Electrical World:

SIR:—Referring to the letter in your issue of Jan. 6 by Mr. Chester I. Hall regarding "Registering Maximum Demand," I would say that my letter of Dec. 2 was not written as an attack upon the company which evidently Mr. Hall represents, but was aimed at a system which makes possible the conditions to which my letter related.

In view of Mr. Hall's communication I will revise my previous question as follows: "The American owner of Patent No. 722,030 states that these maximum-demand attachments can be expected to be on the market in the next few months, but where have they been for the past eight years?" and express my query in this form: What would have been the result, as far as the American public is concerned, had the American company been unable successfully to negotiate with the English owners? Would we calmly wait for the patent to expire or would someone commence the manufacture of the device and trust to a court of justice sustaining that action? My own tentative answer would be that we would wait—calmly or otherwise—until the life of the patent had run its course, inasmuch as we have already let eight years elapse without forcing an issue.

Providence, R. I. CECIL W. BROWN.

THE SMALL ELECTRICAL CONTRACTOR.

To the Editor of Electrical World:

SIR:—When a householder wants a little electrical wiring job done to whom does he apply? Suppose the lady of the house has been for some time back an advocate of electric vacuum cleaning and finally the theoretical if not the actual head of the establishment has yielded his official assent. Some new baseboard outlets are required and a competent person should determine what rearrangement of the wiring is necessary to carry the added service with safety as well as with convenience. The man who wants this work done may or may not apply to the electric-service company from which he buys his electricity. He may recall that he has seen the sign of an electric-construction man down the street, and, without giving the matter very much attention, step into the shop and leave the order.

The small electrical contractor and repair man whose sign has caught the eye of our hypothetical citizen is one of a large class. In each of the large cities there are a few electrical construction firms with experience, equipment and resources sufficient to undertake the wiring and electrical installation of the large buildings. These concerns get the big jobs and are usually well-known firms or of recognized standing. But in addition there are a large number of electrical contractors in a small way of businesss scattered throughout the remainder of the city. They get smaller jobs and much of the repair work. These small electrical contractors embrace men and firms of the most diversified type. Some of them are competent, careful and reliable, lacking only capital, organization and prestige to enable them to bid on large contracts with exacting requirements; others are not to be trusted to repair an electric doorbell that won't ring. Yet, it is to be remembered, these men sustain an intimate relation with the general public. There are hundreds of them in every large city and probably tens of thousands of them in the whole country. They are, to a great extent, the advisers of Brown, Smith, Robinson et al. in the minor electrical affairs of life. In the aggregate they wield a powerful influence on the electrical industry. They are doing a work which is indispensable, and it is highly important that they should be honest and competent.

It requires little capital and few tools for a wireman to start in business for himself and hang out his sign as an "electrician." Often he does not even have a shop, conducting his odd-job business from his home. Of course, every man has the right to launch out on his own account, provided he complies with the legal license or other requirements, if any, applying to his particular occupation. In the case of electrical contractors there are license requirements in few, if any, of the states. But it is hard on the public, hard on the competent men in the business and hard on the reputation of the electrical industry that the incompetents should be weeded out, in the course of years, at their expense. Many of the small electrical contractors are unfit to attempt jobs of electrical wiring and do not know how to conduct a business. The electrical jobbers all unite in saying that the small electrical contractors, as a class, cause the credit men more "grief" than any other class of men in the industry.

In Chicago an educational campaign for electrical contractors is under way, and it is of much promise. In that city there are two associations—one of the large "downtown" electrical contractors, and the other of the smaller concerns in the outlying districts. The latter bears the rather unexpected but encouraging name of the Faraday Electrical Association. These two bodies of men are holding monthly joint meetings where the general uplifting of the business is discussed. The effort is not only to raise the standard of electrical construction in Cook County, Ill., but particularly to educate the small contractor to understand more fully what he is about, to keep accounts that will show him just where he stands and whether he is justified in going on, and to take an honest workman's pride in good work fairly paid for. It is an effort, by cooperation, to develop the worthy electrical contractor doing a small trade into a well-rounded business man, and to eliminate the incompetent, dishonest and unfit—the class of men known in England as "jerry wirers," and a disgrace to the industry wherever found. Such a movement deserves praise and widespread emulation.

Chicago, Ill. JAMES L. MORTON.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Speed Regulation of Three-Phase Motors.—G. Meyer.—The first part of a paper, illustrated by numerous diagrams, on economic methods of speed regulation of three-phase commutator motors. The author first discusses the series motor and its speed regulation by changing the voltage at the terminals or the position of the brushes and then takes up the three-phase motor with shunt characteristics, of which he considers the Winter-Eichberg type. The author considers this problem as one of economic importance. He estimates that the price of the electrical energy yearly wasted in the regulation of three-phase induction motors in German industries is something like $800,000.—*La Lumière Elec.*, Jan. 6.

Synchronous and Non-Synchronous Reactance.—J. Rezelman.—A further article in his long illustrated serial. In the present instalment the author deals with a four-pole turbo-alternator, the reactance of which is not constant, but depends upon the relative position of the rotor and stator coils. The effect of the squirrel-cage winding, formed by the brass wedges and bronze winding covers, is investigated for various conditions.—Lon. *Electrician*, Jan. 12.

Rectifier.—P. Mombellet.—An illustrated description of the new rectifier of Soulier, which differs from a former instrument of the same author in that both half-waves of the alternating-current wave are utilized.—*La Houille Blanche*, November.

Lamps and Lighting.

Incandescent Lamps.—The first part of a paper on recent progress in incandescent lamps. The author estimated the yearly consumption of incandescent lamps in Germany in 1909 as 20,000,000. In spite of the great increase in the use of electric light due to progress made in metallic-filament lamps, the number of lamps consumed per year in Germany is now not larger than in 1909. This is explained by the very long life of the metallic-filament lamp. The author discusses the progress made in the metallic-filament lamp and deals especially with the use of drawn tungsten filaments. He refers to a new tendency which has recently manifested itself, namely, to increase the efficiency at the expense of life. This tendency is considered to be justified as long as the metallic-filament lamp is not much more expensive than an ordinary carbon lamp. He compares the cost of electric lighting by metallic-filament lamps with a squirted filament (price of lamp, 62.50 cents; specific consumption, 1.3 watts per hefner cp; useful life, 1000 hours) with the cost of lighting by metallic-filament lamps with a drawn filament (possible price of lamp, 25 cents; specific consumption, 0.8 watt per cp; useful life, 500 hours). The cost of operation for 1000 hours in the former case is $5.83 against $3.70 in the second case. The author does not think that the drawn filament is superior in every respect to the squirted filament. The latter becomes better during use, while in the former (in the drawn tungsten as well as drawn tantalum filaments) the coherence of the filament gradually decreases during use.—*Zeit. f. Beleucht.*, Jan. 10.

Series Arc Lamps.—A. Hess.—A paper on a high-tension installation of series arc lamps at the exhibition in Turin. There are 240 lamps, each consuming 10 amp and furnishing 2400 cp all together. These lamps are arranged in two series of 120 each. In order to be successful the lamps must have satisfactory mechanical regulation independent of all sudden changes in voltage or current. This is stated to be fulfilled by the Conta lamp. To prevent the failure of a single lamp from causing extinction of the entire series special substitution resistors are built into each lamp. In an emergency these can carry the full current, but while the lamp is in action only a small fraction of the total current, about 1.5 amp, will pass through. It is estimated that had this system been arranged on the usual low-tension methods the extra cost per lamp in copper would have been $12 for mains alone. The cost of running the entire system for an evening of four hours is $12 ($6 for electrodes and $6 for energy). This amount is equivalent to about 12 cents per lamp-hour.—*Illuminating Engineer* (London), December.

Iron Resistors.—The light variations in electric car lighting caused by the fluctuations of the voltage in the trolley wire can be easily avoided by the use of properly proportioned iron resistors (in an indifferent atmosphere, for instance, in a globe filled with hydrogen) such as are used as "ballast" for the Nernst lamp. The design of such iron resistors used by the Allgemeine Elektricitäts Gesellschaft is discussed.—*Zeit. f. Beleucht.*, Jan 10.

Generation, Transmission and Distribution.

Electric Power in Quarries.—An illustrated description of the uses of electric power at the Buxton lime firm's quarries in the Peak district of Derbyshire. The present generating plant consists of a 250-kw and a 160-kw, three-phase generator. Some 800 hp of motors, practically all of the "cascade" type, are being used. Concerning the "cascade motor" the following information is given. The simplest type of this machine has a short-circuited rotor without slip-rings. Speed variation is obtained by means of regulating resistances connected to tappings in the stator winding, and full-load starting torque is obtained with full-load current. The stator is provided with a single winding of the regular barrel type and differs from that of an ordinary motor only by having the coils connected to form two parallel groups per phase. From symmetrical points in the winding tappings are taken equivalent to equalizing connections. The rotor winding is of the barrel type, with one-quarter of the coils omitted. The omission of these bars gives the winding the property of simultaneously producing two magnetic fields, one having a number of poles corresponding to that of the stator winding and the other with half this number. The second field rotates in the opposite direction from the first, and generates emf in the stator winding. By coupling pairs of stator tappings paths are formed for the circulation of these currents, and by the use of resistors these currents can be controlled. The windings of the rotor consist of groups of parallel-connected coils, so that only very low voltages exist even at start. In a 50-hp motor the maximum emf does not exceed 12 volts. In the case of the two-speed motor extra rotor windings are required and three slip-rings with resistors; with the cutting out of the stator resistors the motor reaches its first efficient synchronous speed, while similarly the cutting out of the rotor resistors gives the second efficient synchronous speed. The efficiencies at both speeds are high, those of the 100-hp motor being 91 per cent at the first speed and 89 per cent at the two-thirds speed with the same torque, the corresponding power factors being 0.93 and 0.86. —Lond. *Elec. Review*, Jan. 12.

Electric Driving of Rolling Mills.—C. A. Ablett.—A paper read before the (British) Institution of Electrical Engineers. The author describes two devices which were designed for rendering the employment of flywheels useful on electrically driven rolling mills. The author describes

the permanent-slip regulator and intermittent-slip regulator. The difference between the practical and theoretical results is illustrated. The best arrangement of the motor and flywheel to correspond with the system of power supply employed is dealt with, as are also the adaptability of the Ilgner system for this purpose and the comparative advantages of three-phase and direct current for merchant mill driving.—Lon. *Electrician*, Jan. 12.

Lifting Magnets.—E. PFIFFNER.—The first part of a paper on the calculation of lifting magnets. The author first gives the general equations and shows that the cost of manufacture becomes a minimum when the dimensions are so chosen that the cost of the iron equals the cost of the excitation windings. He then discusses the saturation of the iron and the influence of the excitation on the tractive force.—*Elek. Zeit.*, Jan. 11.

Electric Braking.—F. NIETHAMMER AND E. SIEGEL.—An article on the different methods of electric braking with special reference to the use of single-phase commutator motors for braking.—*Elek. u. Masch.* (Vienna), Dec. 24 and 31.

Traction.

Single-Phase Traction.—J. SIMEY.—An account of trials made by a French railroad company with a system in which the line is fed with high-tension single-phase current which is transformed on the locomotives into direct current by means of special rotary converters designed by Auvert and Ferrand. The motors are direct-current machines. For starting and speed regulation the voltage impressed on the motors is changed by a displacement of the brushes of the converters.—*La Lumière Elec.*, Dec. 30.

Simplon Tunnel.—P. RIGOTARD.—A fully illustrated description of the electric operation of the Simplon tunnel. The three-phase traction system is used and the equipment of the line, of the generating plants and of the locomotives is described.—*La Revue Elec.*, Jan. 12.

Block Signals.—R. EDLER.—An illustrated article on block signals, with special reference to the methods of preventing a train from leaving a station until the line is free and also the possibility of countermanding the permission to leave the station if the train has not yet left it.—*Elek. u. Masch.* (Vienna), Jan. 7 and 14.

Installations, Systems and Appliances.

Resistor Material.—A note on a recent British patent (1459, Jan. 4, 1912) of H. T. Jones. A material suitable for rheostats, controllers, heaters, etc., is procured by first dissolving North Carolina pine tar in a solvent such as carbon bisulphide. Graphite in solid black form is then thoroughly impregnated with this solution and heated.—Lond. *Elec. Enging*, Jan. 11.

Wires, Wiring and Conduits.

Insulators.—W. WEICKER.—A paper on the protection of high-tension insulators, and especially suspension insulators, against dangerous rises of voltage. The paper is profusely illustrated.—*La Revue Elec.*, Dec. 22.

Electrochemistry and Batteries.

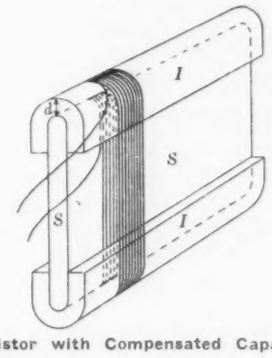
Electric Crucible Furnaces.—An illustrated description of the Helberger furnace in which the crucible and the alternating-current transformer are built together in the same apparatus. Connected to the low-tension side of the transformer are two specially designed holding mechanisms equipped with water-cooling devices, which grip the plumbago or graphite crucible. The crucible itself, therefore, forms the resistor and is heated directly by the electric current.—Lond. *Elec. Review*, Jan. 12.

Electrolytic Oxygen.—F. PELZ.—An article in which the author shows that the electrolytic decomposition of water is a commercial and easy method for making oxygen of 99 per cent purity and hydrogen of the same purity on a commercial scale. Special reference is made to the Schuckert apparatus, and attention is called to the possibility of using this process at times of low load in central stations. Figures of cost are given.—*Elek. Zeit.*, Jan. 11.

Primary Battery.—A note on a recent British patent (No. 9528 of Dec. 28, 1911) of A. Sandrini and C. Sanguineti. In a cell comprising a porous jar, a metallic rod and a saline solution the former is made from a mixture of carbon, peroxide of manganese, tar, sulphur and water, and is heated in a mold to about 250 deg. C. The rod is a combination of eight parts of zinc with two parts of aluminum, or zinc alone covered with a permeable fabric. The solution is formed of two parts of sodium bichromate, eight parts of sodium chloride and 0.6 part of crystals of pyrosulphuric acid for ordinary uses; but if a constant current is required over a long period the above ingredients in the proportion of eight to twelve to one respectively are required.—Lond. *Elec. Eng'ing*, Jan. 4.

Units, Measurements and Instruments.

Compensation of Capacity of Resistors.—E. ORLICH.—The capacity of resistors of large resistance may be compensated by giving them a certain self-induction. For this purpose the resistance wire is wound unifilarly around a slate plate *S*. Two covers *I* and *I* are then placed over the upper



Resistor with Compensated Capacity.

and lower rim and the wire is now wound backward in the opposite direction, the number of windings being the same. The construction is indicated in the illustration above. If the distance d between the two windings is made equal to 0.0015 $R \div n$ cm, when R is the total resistance (presumably in ohms) and n the number of turns per centimeter length, then the capacity is compensated by the self-inductions for all frequencies. Experiments have confirmed the correctness of this formula.—*Verh. d. Deutsch. Phys. Gesellsch*, Vol. XII, page 949; abstracted in *Elek Zeit.*, Jan. 11.

Heating Effect of Currents in Measurements of Electric Resistances.—R. T. GLAZEBROOK, W. R. BOUSFIELD AND F. E. SMITH.—One of the authors formerly described an experiment in which the passage of a current of 4.4 amp through an oil-cooled manganin resistor of 1.2-mm wire produced an increase in the resistance corresponding to an increase of temperature of 60 deg. C. As the cooling surface of the resistor was 16 sq. cm per watt, such a large increase of temperature was thought to be improbable, and the change of resistance was attributed to some other cause. However, the effect of the passage of the current was similar to that resulting on raising the temperature, and because of this it was proposed to call the change a thermoid effect. With platinum wires similar results were obtained, the increase of resistance being nearly proportional to the square of the current and inversely proportional to the radius of the wire. The question as to whether the rise of the resistance is due entirely to increase in temperature or due in part to some other fact is of extreme importance for precise electrical measurements. The authors have now made a series of experiments to decide this question, and they conclude that the heating effect of the current was the sole cause of the observed increase of resistance. They add, however, that when electrical measurements are made with wires not carefully annealed the

passage of a current through them does often produce permanent changes in the resistor. In addition, therefore, to the rise of the temperature of a wire a current may so alter the molecular structure as to change, temporarily or permanently, the specific resistance. Very similar effects may be produced by a cycle of temperature, and it is at present difficult to say whether or not the change in the specific resistance is due entirely to the change of temperature of the wire. With well-annealed wires the changes are small.—Lond. *Electrician*, Jan. 5.

String Galvanometer.—E. F. Huth.—An illustrated description of a string galvanometer the principal new feature of which is the design of the magnet. The string is in the center of gravity of the galvanometer, so that it is disturbed only a very little by ordinary vibrations.—*Phys. Zeit.*, Jan. 1.

Wattmeter for Cable Tests.—An illustrated description of a wattmeter of English make for determining the dielectric losses in a 30,000-volt cable.—Lond. *Electrician*, Jan. 12.

Meter.—An official article of the Reichsanstalt on a new construction of direct-current motor meters for from 300 to 2500 amp made by the Isaria Meter Works.—*Elek Zeit.*, Jan. 11.

Anemometer—R. Chasseriand.—An illustrated description of the electric recording anemometer (wind gage) of Richard, and some notes on the measurement of atmospheric electricity.—*La Lumière Elec.*, Dec. 30.

Telegraphy, Telephony and Signals.

Direct Distribution for Main Telephone Underground Cables by Means of Parallel Cables in the Same Pipe.—E. D. Pink.—A note on a recent paper read before the Institution of Post Office Electrical Engineers in London. The author explained that in the original method of distribution, which was still in vogue, a main cable was led out from an exchange, and at a distributing center, such as the junction of several pipe routes, its conductors were fanned out in what was known as a cable distribution head, being possibly a second main cable of smaller size and a number of distribution cables radiating in the vicinity, from which the single pairs for serving subscribers' premises were taken off. As telephonic development advanced in any particular direction so the number of distribution cables was added to, and the pipes became so badly congested that in attempting to find accommodation for an additional cable the existing plant became seriously damaged. One of the objections to filling a pipe with distribution cables was that their multiplicity struck a blow at the "draw-in" system. Such a system should also of necessity be a "draw-out" system, but the possibilities of drawing out one cable independently diminished rapidly with each cable added beyond five or six if the length of the pipe section were considerable, say from 300 ft. to 450 ft. The rods used to thread the pipe with the "drawing-in" rope made their way in and out of the existing cables in a strange wormlike manner, so that the cables became, as it were, locked together and it was impossible to shift them independently. Another objection was that the space occupied by lead, the protecting medium, became disproportionate to that occupied by copper, the all-important conducting medium. As an example of parallel distribution a 150/10 cable leaving an exchange or a branch joint of a larger main cable might be considered. At the first footway box in the thoroughfare to be served the sheath of the main cable was opened sufficiently to allow the last seven pairs to be cut and joined to a distribution cable. A split lead sleeve was used to make this opening good by means of a wiped joint, the distribution cable forming a branch on the main. The two cables were accommodated in the same pipe, and at a point where it was estimated they would have passed the frontages of fourteen probable subscribers the far end of the distribution cable was joined to the next seven pairs of the main. By this means one distribution cable was capable of serving fourteen subscribers. A traffic center was fixed; the subscribers on the exchange side of the center were connected to the higher numbers and those on the more distant section were accommodated on the lower numbers of the fourteen pairs allotted. At the same point as that from which the second set of seven pairs was taken off a third set was jointed to another distribution cable going forward. At this point practically twenty-five pairs had been used up and the main could be reduced proportionally. Similar means were adopted with the 100/10 cable till it was reduced to a 50/10, when it was treated in a like manner, and finally the distribution cable went forward alone. In conclusion, the author said that it was his desire to show that "parallel distribution" is superior to the method which has hitherto been in vogue from the standpoints of expenditure, expediency, increased carrying capacity of existing plant, maintenance and renewals. Indeed, to his mind it is the solution of underground distribution.—Lond. *Electrician*, Jan. 12.

Miscellaneous.

Electrical Laboratory.—F. G. Baily.—The first part of a description of the electrical engineering laboratory of the Heriot-Watt College in Edinburgh.—Lond. *Electrician*, Jan. 5.

Electrically Produced Water Ripples.—F. Palmer, Jr.—A description of a simple method of producing water ripples by means of the discharge from an induction coil and the use of this method for the demonstration of optical phenomena, especially interference and diffraction. The method is a modification of that of Pfund.—*Phys. Review*, December.

Arnold.—An account with portrait of the life and work of the late Prof. E. Arnold.—*Elek. Zeit*, Dec. 21.

Book Reviews.

Wireless Hook-ups. With a chapter on the study of diagrams. By H. Gernsback. New York: Modern Electrics Publication. 96 pages, 171 illus. Price, 25 cents.

A little handbook intended for the use of experimenters in wireless telegraphy. The diagrams of connections are clear and easy to follow. No attempts are made to explain the modes of operation in the different diagrams, but the title of the diagram offers a certain amount of explanation. The book will be useful to the amateur experimenter.

Straight Line Engineering Diagrams. By Manifold and Poole. San Francisco, Cal. 44 diagrams. Price, $3.

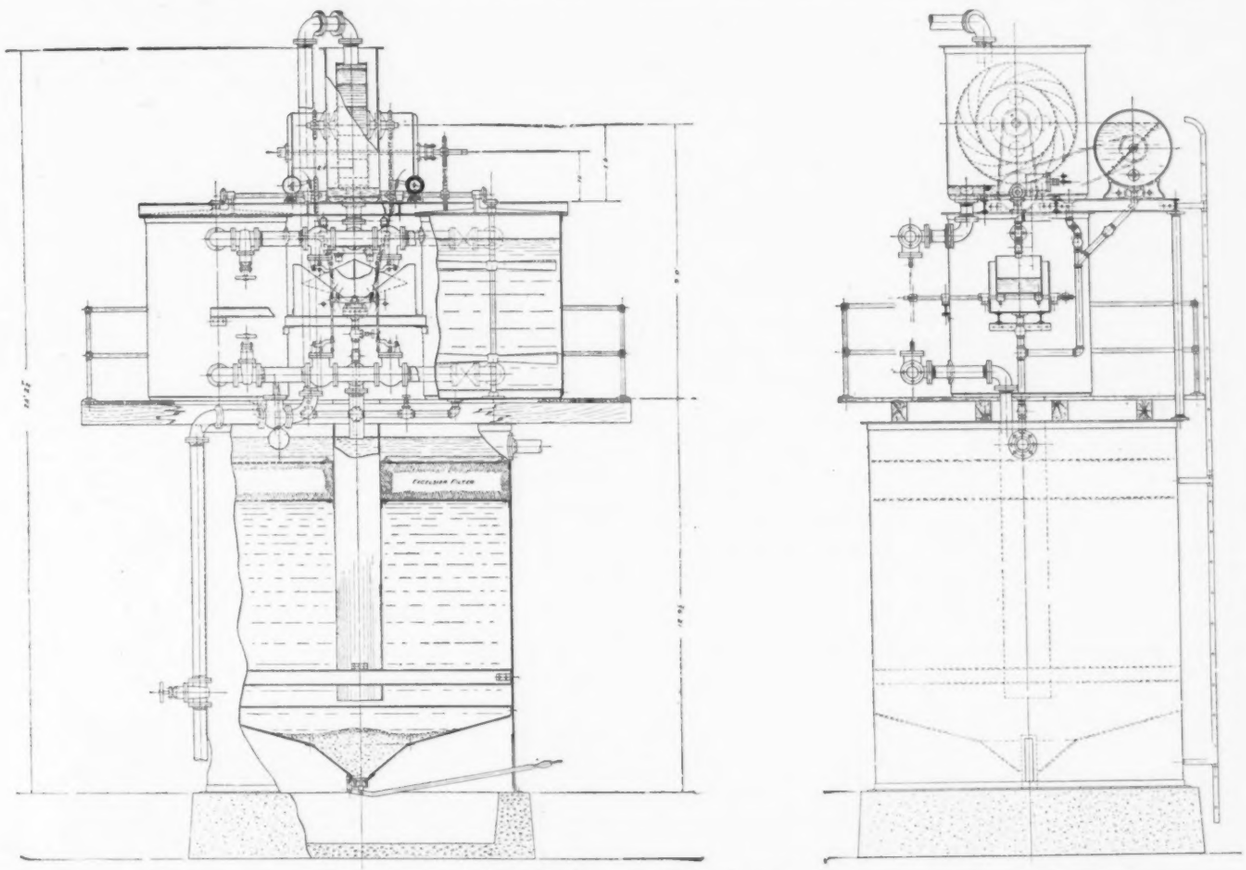
A useful engineers' pocket-book by the aid of which a large number of practical problems can be worked out by inspection. Three or more graduated lines, usually straight and parallel, are engraved on each sheet and, at least two factors being given, the remaining corresponding factors can be deduced by laying a straight line across the diagram connecting the two points known. The subjects dealt with in successive diagrams are bearing power of piles, masonry arches, strength of concrete, concrete steel, strength of beams, direct-current wiring, pole-line construction for both copper and aluminum, electric circuits, power-transmission lines, comparative cost of power, steam hoists, steam engines, economic size of pipe, flow of water in small pipes, canals in earth, water-power, steel pipe line, flow of water in pipes, wood-stave pipe lines, flow of water over weirs, flow of water in canals and flumes, water measurements, stadia measurements, shafting, gearing and belting. The diagrams will be of use to the engineer in field work, in estimating and in making computations generally. Taken collectively they are particularly adapted for the use of the constructing engineer on the Pacific Coast in hydroelectric power-station and transmission work.

New Apparatus and Appliances

AUTOMATIC WATER SOFTENER.

The accompanying illustrations show sectional views of the new automatic water softener or purifier made by the George W. Lord Company, of Philadelphia, Pa.

In this purifier the water enters through the inlet pipe at the top, passing over a wheel which furnishes the power for the operation of the filter. The waterwheel shaft is connected by a chain-drive with a horizontal shaft, driving through miter gears, the two vertical paddles for agitating the water in the mixing tanks and thus aiding the precipitation of the injurious solids. The waterwheel also drives paddles in a chemical storage tank, continually agitating the solution of chemicals and keeping it of a uniform consistency and strength. These purifiers are also equipped with chemical measuring valves, operated by a dumping bucket, which regulate the amount of chemicals used from time to time. The bucket in addition operates a series of lower valves, opening and closing these at proper intervals, to give complete automatic action.



Automatic Water-Purifying System.

Leaving the wheel, the water enters the upper line of pipe and flows alternately to the right and the left, its course being regulated by the lever valves above referred to, which are connected with the inflow and outflow pipes.

After agitation is completed, the water flows through a center-partition cylinder into the main filter tank, which separates the raw water from the treated water. From here it ascends through the filters, finally overflowing into the storage tank at the side, or directly into the boilers.

The precipitates, in the meantime, settle into the funnel-shaped base of the filter tank. Some may be carried upward a short distance, but being heavy their tendency is to settle, and in doing so they come in contact with other particles with which they unite, causing all to fall to the base. From here they are removed through a sludge valve discharging into the sewer. The filters remove any remaining trace of precipitates, the final result being a perfectly pure water, suitable for manufacturing or industrial purposes.

The chemical measuring valve provides a definite amount of the reagents required for precipitating the injurious solids. This valve is equipped with an inner measuring cup and a brass sleeve on its outside cover, which this cup slides back and forth. The cup itself has openings top and bottom, allowing the air to pass in and out at proper intervals. The valve is operated by a dumping bucket, which, as it tilts back and forth, causes the opening in the inner cup to rotate to points opposite the two ports on the right and left. One of these leads to the chemical storage tank, and the other to the mixing tank. This allows the measuring valve to be filled and emptied at regular intervals, making the action entirely automatic. In this way a definite amount of chemical solution is fed into the mixing tank as needed to precipitate all the injurious solids. The float valve on the inlet pipe is operated from the storage tank, cutting off the supply of water as the storage tank fills.

The Lord water softener described was designed for the cold treatment of feed waters, especially in plants where a large battery of boilers is required, or where a water highly concentrated with injurious solids is being used. An important feature not overlooked is that of installation cost, avoiding the necessity of purchasing an expensive machine.

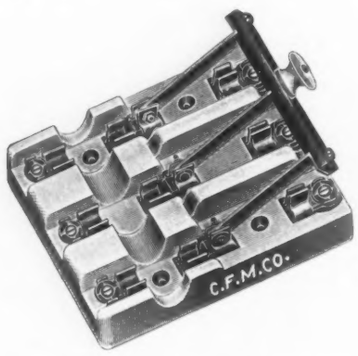
CHICAGO AUTOMOBILE SHOW.

Nearly 400 exhibits of gasoline and electric pleasure vehicles and accessories occupied the Chicago Coliseum and First Regiment Armory during the week just closed, while the second week of the Chicago Automobile Show will be given over to commercial trucks. The Coliseum was, as usual, specially decorated for the show, a feature of the lighting being the use of 500-watt tungsten units under the balcony of the main auditorium.

Electric vehicles were exhibited in both showrooms, among those represented being the Baker, Borland, Columbus, Detroit, Flanders, Hupp-Yeats, Ohio Electric, Rauch & Lang, Standard, Waverley and Woods cars. The Electric Storage Battery Company and the Edison Storage Battery Company maintained booths. Several electric self-starters were shown in various exhibits, but these were greatly outnumbered by the compressed-gas starters which have been applied to many 1912 cars. Electric-lighting systems, except as shown furnished with the higher-priced cars, were in little evidence at the present show. The 1912 models see more gasoline cars than ever adopting the left-hand drive, the advantages of which have been embodied in practically all electric vehicles since the early days of automobile design.

COMBINATION SWITCH AND CUT-OUT.

The Chicago Fuse Manufacturing Company has recently put on the market a line of combination switch and cartridge fuse cut-outs ranging from 3 amp to 60 amp for 250-volt circuits. With the recent ruling of the Underwriters against the use of mica plug fuses on 250-volt circuits there has been need for a compact unit serving as switch and cut-out for motor work as well as entrance-service cut-outs. The illustrations herewith show the double-pole and triple-pole blocks arranged for wires entering at the bottom when mounted in the upright position, the fuses protecting the device itself and the switch tending to fall down when not in use, thus complying with the suggestions of the Underwriters for the proper installation of knife switches. These switches are also made for wires



Combination Triple-Pole Switch and Cut-Out.

entering at the top. The bases are sufficiently thick to allow 1-in. spacing for knob and tube work and where used in basements or other damp places. The cross-bars are of heavy fiber, having the knife blades mortised into them and securely attached by a screw. The clips are punch-formed and made of copper with liberal thickness to insure a lasting spring contact and cool operation under continuous load. The hinge contacts are formed in strict accordance with the Underwriters' specifications. The manufacturers state that the aim in design throughout has been to make a more rugged and serviceable switch and cut-out than those commonly met with on the market.

ANNUAL CONVENTION OF NATIONAL CARBON COMPANY'S SALESMEN.

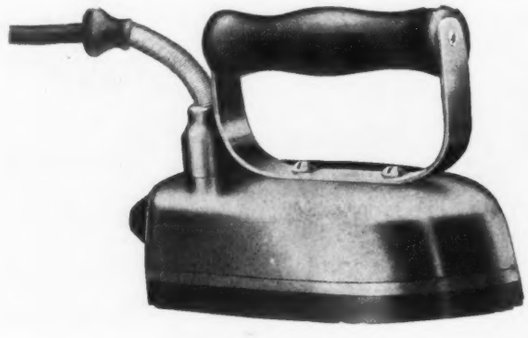
The sixth annual salesmen's convention of the National Carbon Company was held at Factory "A," Cleveland, Ohio, Jan. 22-27 inclusive. Nearly 150 people representing the management, sales and engineering departments of the nine factories were in attendance. The program included the presentation of no less than twenty-four papers pertaining to the carbon industry and carbon products. Of these eight dealt with the dry battery and with ignition systems; four were on electric carbons and lamps, three on brushes, five on selling and advertising and four on miscellaneous subjects.

The morning sessions of the convention week were devoted entirely to practical demonstrations of the company's various products and apparatus in which these products are used, leaving the afternoon sessions for the presentation and discussion of papers. The sixth annual salesmen's banquet was held Thursday evening, Jan. 25, at the Colonial Hotel, Cleveland.

ELECTRIC FLATIRON.

Illustrated herewith is an electric flatiron made by the Bon Ami Electric Company, of Milwaukee. This utensil is made in four parts, consisting of the bottom, the heating element, the top and the handle. The assembling is done by putting two screws through the handle, the top and the heating element and securing them into the bottom plate, which is 0.5 in. thick. The iron is simple and durable, and renewal parts can be installed by the user, a screwdriver being the only tool needed. The bottom plate is made thicker than is usually the case, in order to get a larger amount of heat storage.

The heating element is self-contained, with the terminal contacts in place, so that no connections are necessary when there is occasion to renew the element. It is made of a molded asbestos compound of such shape that the coil, which is a flat wire wound in the form of a spiral and fitting into a groove, is so situated as to give the best distribution of heat. The groove is 0.125 in. deep by 0.5625



Electric Flatiron.

in. wide. After the spiral is placed in it it is filled with a special cement, which is a good conductor of heat. This construction results in the bottom of the iron being heated very quickly. The contact plug is incased in metal and there is a knob on the cord by which the plug may be pulled from the receptacle in the rear of the iron. This knob is anchored to the shell of the contact plug in such a way that no strain comes on the cord. The power consumption is 495 watts. Mr. T. M. Caven, the designer of this flatiron, asserts that some of these irons on test have been operated continuously for over 2000 hours at 500 deg. C. and as yet do not show any signs of breaking down.

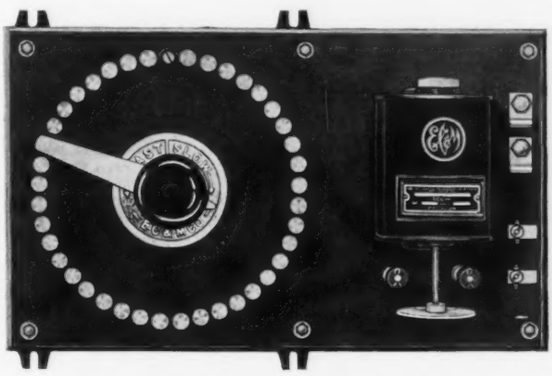
MOTOR FIELD-CIRCUIT RHEOSTATS.

The Electric Controller & Manufacturing Company, Cleveland, Ohio, has recently placed on the market a line of motor field-circuit rheostats for varying the speed of adjustable-speed and constant-speed, direct-current motors. The resistor units consist of small cast-iron grids insulated with asbestos and wound with resistor wire, these units being carried by the slate face-piece and fastened directly to the contacts. The resistor wire has an unusually low temperature-resistance coefficient, so that the resistance of the rheostat—for any one setting—does not increase with the heating and thereby alter the speed of the motor which it regulates. An interesting adjunct to these rheostats is what has been designated the field rheostat relay. It is well known that a shunt-wound or compound-wound motor should be started from rest with full field strength, and, in fact, if the shunt-field current is weakened to a large extent it may be impossible to accelerate the motor, because of insufficient torque, prohibitive sparking at the commutator, or such a large volume of current that fuses would be blown and circuit-breakers opened. It has, therefore, become the preferred practice to return the rheostat handle to the position of full field strength every time the motor is started.

The field rheostat relay has been developed to prevent starting the motor with a weakened field. This relay consists of a magnet coil or solenoid through which passes a steel plunger carrying at its lower end a contact plate for electrically connecting two contact studs. The magnet coil and the plunger are inclosed in an iron case, which serves not only for protection but acts as a part of the magnetic circuit.

The relay coil is connected in series with the armature circuit of the motor, and the two contact studs are connected to the terminals of the motor field rheostat so that the rheostatic resistor is short-circuited when the contact studs are bridged by the contact plate.

The relay coil is so designed that when the armature current exceeds a predetermined maximum the plunger is drawn up, thereby causing the contact plate to connect the two contact studs, thus cutting out all of the resistance in series with the shunt-field circuit. This gives the motor its



Motor Field-Circuit Rheostat with Relay.

full field strength and consequently its maximum torque, enabling it to accelerate its load properly. As the current decreases, owing to the speeding up of the motor, the relay plunger drops, inserting the rheostatic resistor in the shunt-field circuit and weakening the field current. This cycle of operation is repeated until the motor has been safely brought to the proper speed as determined by the setting of the motor-field rheostat.

The field rheostat relay makes the starting of adjustable-speed and constant-speed motors thoroughly safe, no matter what the setting of the motor-field rheostat may be. It permits of setting the field rheostat to give the most efficient motor speed for the work in hand, and no matter how often the motor is started and stopped it will invariably run at this efficient speed. It saves the time of the operator, who no longer has to adjust his motor-field rheostat after the motor is safely started.

The motor-field rheostat here described is rated up to and including 50 hp at 110, 220 and 550 volts, and in general will provide for a maximum speed variation of 4 to 1.

TRANSFORMER OIL DRIER AND PURIFIER.

With the extremely high voltages common to the present-day transmission systems it is absolutely necessary that the transformer oil be maintained free from moisture and foreign substances which reduce the dielectric strength and render the transformer unable to withstand the heavy stresses it is subjected to. The General Electric Company has developed a transformer oil drier and purifier which effectively removes water, solid matter, slime, etc., from transformer oil. As a result of tests it has been demonstrated that an excellent method for removing these substances from oil consists in forcing it under high pressure through several layers of dry blotting paper. All solid matter is caught by the first layer of paper, while the water is retained in the paper by capillary attraction as the attraction between the paper and water is greater than that between the paper and oil.

For the utilization of this principle specially designed filter presses of several sizes and capacities have been developed, each comprising a special form of press, mounted on a base frame of I-beams and provided with pump, motor, piping, drip pan and auxiliary devices. The essential portions of the filter consist of a series of alternate flat cast-iron plates and frames, the blotting paper being placed between them and the whole clamped tightly by means of a large screw and lever at one end. Both plates and frames have large cored holes in the lower corners, serving as inlet and outlet for the oil.

Since the plates and frames are very thin and are connected so that the oil circulates in parallel, a large filtering surface with correspondingly large output is obtained in a small space. The 12-in. size, containing twenty chambers with forty sets of papers and five layers each, has a total length over the active portion of only 22.5 in., yet will filter at the rate of from 15 gal. to 30 gal. of oil per minute.

Use is made of a rotary-gear or multi-stage centrifugal pump, depending on the size of the filter and the individual requirements of each case. The rotary-gear, positive-pressure pumps used for the smaller size of filters are extremely simple and compact and are geared to the motors to run at reduced speed. The multi-stage centrifugal pump of the 12-in. size was especially developed with this purpose in view.

An electric drying oven has been developed especially for drying the paper. It is built of sheet steel and is provided with thermometer and regulating rheostat and with heating units designed for 110 or 220 volts. The interior is provided with suspension rods on which the paper may be strung so that it hangs in a vertical position.

In addition to its use in purifying transformer oil the above-described drier may also be applied to the treatment of many other liquids as well as heavy viscous compounds, the latter preferably being slightly heated before treatment to reduce their viscosity.

Outfits are now in constant use for the purification of the following materials: Transformer oil of all kinds, crude petroleum for oil-fired furnaces, insulating varnish and japan, benzine used for cleaning purposes, transformer oil used for impregnating insulating pressboard and wood, cylinder oil used in certain types of electrical apparatus and viscous insulating compounds.

HIGH-VOLTAGE OUTDOOR TRANSFORMERS.

High-voltage outdoor transformers mark one of the comparatively recent advances in transformer design. Where it is not economically feasible to install a substation a transformer can now be mounted on a platform in any

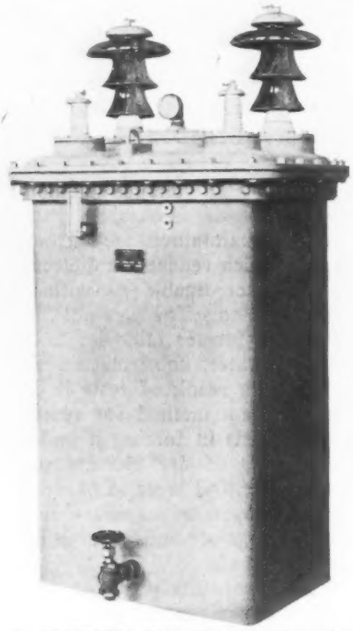


Fig. 1—33,000/2200-Volt Outdoor Transformer.

convenient manner and connected to the transmission line without any provision for protection from the weather. Figs. 1 and 2 illustrate Westinghouse transformers designed for operation in this manner.

Fig. 1 shows a 45-kva Westinghouse transformer with 33,000-volt high-tension and 2200-volt low-tension windings. This transformer is mounted in a case of boiler iron with

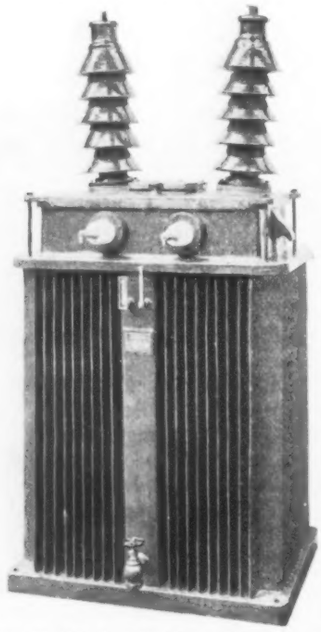


Fig. 2—100-kva Outdoor Transformer.

all seams welded. The low-tension outlet bushings are of corrugated porcelain, while the high-tension bushings are built up of porcelain petticoats. Both sets of bushings are sealed into cast-iron flanges which are bolted to the cover in such a manner as to provide an absolutely watertight joint.

Fig. 2 shows a Westinghouse 100-kva transformer of a somewhat different design and for 53,000 volts. The case is of corrugated-iron sides, with all seams welded, and the top and bottom cast on. A substantial cast-iron cover is bolted to the top, a waterproof gasket fitting tightly between the cover and case. The material of the sides is absolutely pure iron, not steel, and is very little affected by rust. It is further protected by paint, which affords good protection from the weather. The high-tension and low-tension outlet terminals are similar in general design to those shown in Fig. 1 except that the low-tension terminals are brought out on the side instead of upward through the cover.

Transformers of this type are shipped in accordance with the standard Westinghouse practice of shipping transformers filled with oil. When this is done it is not necessary to dry out the transformer when received, and the trouble and delay caused by assembling transformers in cases and filling with oil are avoided. All the customer has to do in putting the transformer into service is to remove the blind flanges from the openings and insert the outlet terminals into place. The transformer is then ready to connect to the circuit.

A PHILADELPHIA THEATER ELECTRICAL EQUIPMENT.

The William Penn Theater, situated at Fairmount and Lancaster Avenues, Philadelphia, was built in 1909, having a seating capacity of 3200 people, at a cost of $400,000. The theater was built to cater to the wants of the large population in West Philadelphia and is devoted to high-class vaudeville productions. In addition to the balcony and gallery there are five floors in the rear, used for retiring rooms, promenades and resting places for the comfort of the patrons. A complete intercommunicating telephone system connects all parts of the house.

The power plant is located in the basement, and electric energy for the lighting and ventilation of the building is generated by two 35-kw direct-current, three-wire generators operating at 110 volts from each side to the neutral. These generators are direct-connected to high-speed engines that receive steam at a pressure of 100 lb. per square inch from two 100-hp horizontal-return tubular boilers.

The generators are of the Westinghouse three-wire type, 110-220 volts, enabling the three-wire system to be supplied with one machine. The third wire is derived from the middle point of auto-transformers connected by means of a two-phase winding to the armature. By this means a balanced three-wire system with its attendant advantages may be obtained in the most economical manner.

The exhaust steam from the engines is used to heat the building. Boiler-feed water is obtained either from the city mains or from wells dug for the purpose on the property, and is pumped to the boilers by means of a Gould triplex pump direct-connected to a Westinghouse 3-hp induction motor.

A view of the generators is shown in Fig. 1. The switchboard consists of three panels of blue Vermont marble, one for each generator and one for the feeders. Each generator panel contains an ammeter for each side of the line, a field rheostat, a voltmeter receptacle, one four-pole automatic carbon circuit-breaker, one four-pole single-throw knife switch for disconnecting the balance coils. The four poles of the circuit-breaker are connected one each in the positive and negative leads and one each in the equalizer connections, of which there is one on each side—positive and negative.

The feeder panel contains a voltmeter for indicating the busbar voltage and three-pole and five-pole knife switches for the various feeder circuits. These switches are double-throw and are mounted in a horizontal position for trans-

ferring the load from the generators to an emergency supply circuit from the lines of the Philadelphia Electric Company.

An indispensable accessory to every theater is a pump for use in case of fire, or what is known as the fire pump. The underwriters in Philadelphia specify that the motor driving this pump shall have a capacity of at least 50 hp. The pump in this case has a capacity of 600 gal. per minute at 250 r.p.m. and will throw two good 1½-in. fire streams. The pump was manufactured by the Goulds Manufacturing Company, Seneca Falls, N. Y., and is geared to a 50-hp, 220-volt Westinghouse induction motor running at 1120 r.p.m., receiving two-phase currents from the lines of the Philadelphia Electric Company. This outfit, which is shown in Fig. 3, is tested at frequent intervals in order that it may always be available for emergency service.

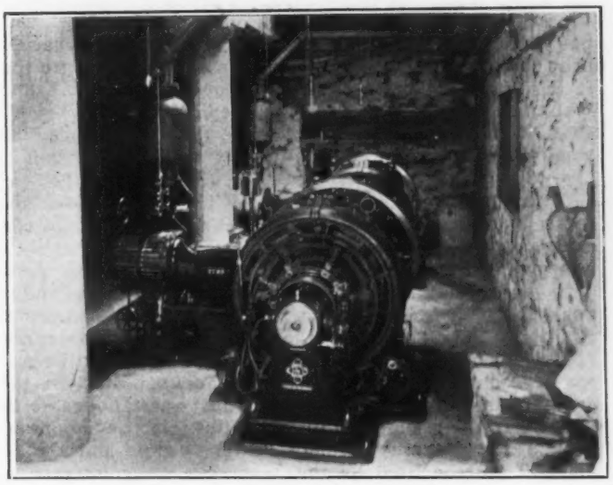


Fig. 1—Three-Wire Generators.

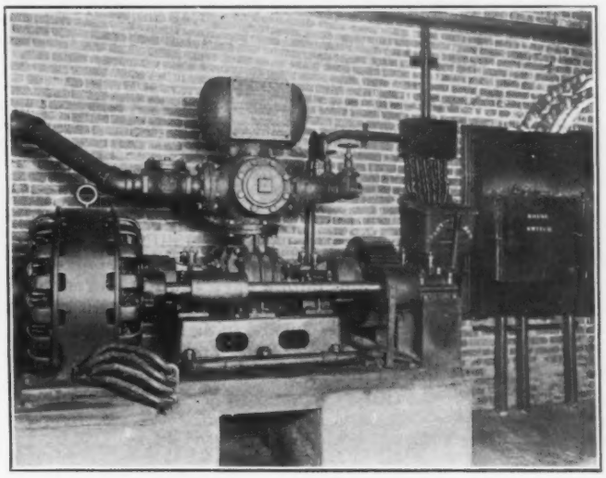


Fig. 3—Motor-Driven Fire Pump.

The ventilation of the house is taken care of by two 60-in. disk fan blowers direct-connected to Westinghouse direct-current motors of 3-hp capacity running at 300 r.p.m. These fans are used to introduce fresh air, which is heated by steam coils in the winter and cooled by water spray in the summer. The auditorium is cooled by thirty-one Westinghouse ceiling fans suspended from the various ceilings formed by the two balconies and the roof. Vacuum cleaner outlets are placed on each floor to facilitate cleaning the building, which is done every day.

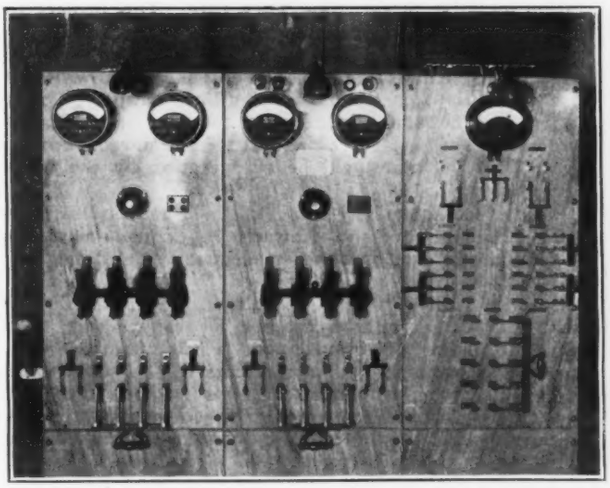


Fig. 2—Switchboard for Control of Generators and Feeder Circuits.

Over 4000 lamps are installed, varying in size from 2-cp sign lamps to 100-watt tungstens. On the lower floor and balcony they are wired on the single-unit system, one lamp to each outlet, to secure better distribution. Over 800 lamps are used on the stage, tungsten and tantalum lamps being employed for the white lamps and graphitized-filament lamps for the red and blue lamps, on account of the shades of light given by the different filaments.

There are twelve stage pockets for the spot lamps and effects, in which arc lamps, of course, are used. The auditorium lamps are controlled from the stage and also from the box office, a special switch installed in the latter place permitting the lights to be controlled independently of the stage.

An interesting feature of the installation was the use of tungsten lamps suspended by 6-ft. chains from the roof of the marquise over the sidewalk. In this position they are naturally subjected to very considerable vibration from the wind, and it was the confident prediction of a great many that tungsten lamps would not stand this vibration. So far not one lamp has been broken in this manner.

As a precaution against any accident to the lighting plant two separate services are brought in from the lines of the Philadelphia Electric Company.

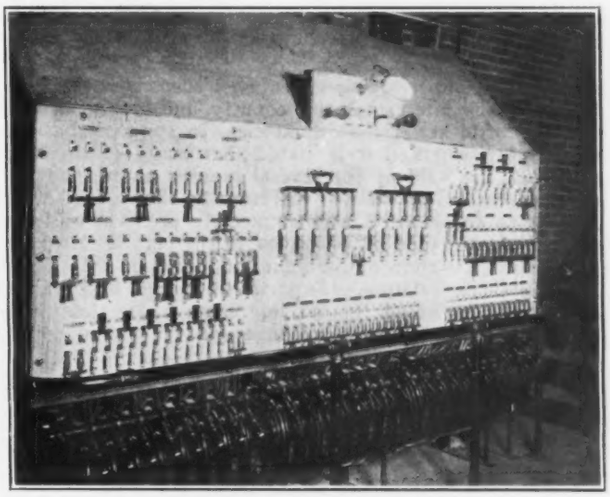


Fig. 4—Stage Switchboard.

The electrical equipment, consisting of generators, switchboard, motors for blowers and pumps, fan motors and lamps, was furnished by the Westinghouse Electric & Manufacturing Company, and all installation and wiring was done by Jos. S. Miller & Company, engineers and contractors, 625 West Girard Avenue, Philadelphia.

Industrial and Commercial News

NET earnings of the United States Steel Corporation for the last quarter of 1911, made public this week, were $23,105,115, as compared with $29,522,725 in the third quarter, and with $25,990,978 in the last quarter of 1910. In spite of the drop of $6,400,000 from the figure of the third quarter, the showing was much better than had been expected, in view of the extremely low steel prices that existed toward the end of the year. The volume of new business placed in the steel markets this week was rather light, and this statement also applies to the pig-iron market. Reports of railroad tonnages are becoming more favorable, and December earnings of several of the roads, made public this week, showed mild improvement. Retail trade is making the best of weather conditions and, on the whole, is fairly active. Transactions in the stock markets are devoid of interest, and public participation is very light. Trade conditions, in general, indicate that a waiting attitude is being maintained toward consummating transactions of any magnitude. The New York money market is very easy, and quotations Jan. 30 were: Call, 2⅛@2⅜ per cent; ninety days, 2½@2¾ per cent.

THE COPPER MARKET.

The copper market continues to drift along very listlessly with no feature of interest in sight excepting the January report of the Copper Producers' Association, which is scheduled for Feb. 8. It is unlikely that any appreciable change will be made by producers in their quotations until after publication of the report. The tone of the market at present is very weak, and electrolytic is freely quoted at 14¼ cents per pound by many of the agencies, while second-hands are willing to make liberal concessions. Some of the larger agencies continue to quote nominally at 14½ cents per pound. Buying was almost suspended this week by consuming interests in this country, and foreign demand was but little better than domestic. In spite of the inactivity in the market, it is stated that many of the large producers are sold up for several months ahead, and that as a decrease in stocks will therefore be shown for several months to come there is no immediate prospect of lower prices. A decrease of 10,000,000 lb. in surplus stocks is the general estimate of the January report of the Copper Producers' Association. Exports since the first of the month, and including Jan. 30, aggregate 30,642 tons. The daily call on the Metal Exchange Jan. 30 quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	13.75	13.85	.....
January	13.75	13.85	13.80
February	13.75	13.85	13.80
March	13.75	13.90	13.82½
April	13.75	13.90	13.82½
May	13.75	13.90	13.82½

The London market Jan. 30 was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	61 7 6	61 15 0
Standard copper, futures	62 2 6	62 10 0

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	14.12½c	13.75c
London futures	65 0 0	61 11 3
Best selected	68 5 0	65 15 0

INDUSTRIAL AND COMMERCIAL NOTES.

Pelton-Doble Combination.—The Pelton Water Wheel Company, of San Francisco and New York, has secured the entire rights, including patents, good-will, patterns, etc., of the Doble Water Wheel business formerly conducted by the Abner Doble Company, of San Francisco. W. A. Doble, former head of the Abner Doble Company, goes to the Pelton Water Wheel Company as its chief engineer, *vice* George J. Henry, Jr., who until recently occupied that position. In addition to Pelton and Doble tangential water wheels, the Pelton Water Wheel Company manufactures the Pelton-Francis turbine, adapted for medium heads and large powers, besides a line of high-grade centrifugal and turbine pumps. Pelton oil-pressure governors are also a feature of this company's product. The Atlantic department of the company, with offices in New York City, has recently completed a large and well-equipped machine shop in Harrisburg, Pa., the two points of manufacture thus facilitating deliveries to all parts of the world. J. V. Kunze, who has been manager of the New York office of the Pelton Water Wheel Company since 1893, has been elected vice-president of the company, but will still remain in charge of the New York office.

Chattanooga-Tennessee River Power Company.—A syndicate of capitalists of Nashville, Tenn., is forming to contract for consumption of the entire energy production of the new plant of the Chattanooga-Tennessee River Power Company on the Tennessee River near Chattanooga, and is now reported to be conferring on the subject with Anthony Brady, of New York City, the promoter of the enterprise. It is estimated that 50,000 hp will be produced, to be paid for at the rate of $20 per hp per annum. Part of this energy will be used by the Nashville, Chattanooga & St. Louis Railroad Company for operating electric mountain-climbing locomotives through Cowan, Tenn., and the remainder will be used by the Warner electric interests in Nashville and the public of Huntsville. The contracting parties have offered to erect a line for transmission of the power along the Nashville, Chattanooga & St. Louis right-of-way to Nashville.

Watson-Stillman Reorganization.—Announcement is made of the reorganization of the Watson-Stillman Company, manufacturer of hydraulic machinery with a plant at Aldine, N. J., and general offices at 50 Church Street, New York. It is stated that the increasing use of hydraulic presses and the steady growth of the business necessitate an immediate extension of the company's manufacturing facilities. To take care of this increased scope it was considered advisable to reorganize the board of directors. The new officers elected are: Francis H. Stillman, president (re-elected); F. A. Stillman, vice-president; J. P. Bird, treasurer; A. F. Stillman, secretary and works manager, and Carl Wigtel, chief engineer.

New Plant for United Electric Light & Power Company (New York).—The United Electric Light & Power Company, of New York City, has revived the plan which it had under consideration in 1907 for erection of a generating station on 201st Street, New York City. This project was laid aside at that time on account of the general business depression which then prevailed. Two 15,000-kw, three-phase, 60-cycle Westinghouse turbo-generators will compose the initial installation. The ultimate capacity of the station will be approximately 150,000 kw. Specifications have been issued for the structural steel required. It is expected that the plant will be in operation by the fall of 1913.

Lansden Company, Electric Vehicle Manufacturer, Sold.—The Lansden Company, Newark, N. J., manufacturer of the well-known line of Lansden electric vehicles, has been purchased by interests represented by W. L. Case, formerly with Mack Brothers, Allentown, Pa. The company name will remain unchanged, but the capital will be increased from $100,000 to $1,000,000. A new factory has been leased in Newark and announcements of the plans of the company will be forthcoming in a week or ten days. Mr. Case is acting as manager of the new company, which will continue to manufacture vehicles ranging in carrying capacity from 1 ton to 5 tons and will also specialize in hotel buses and ambulances.

A Large Crocker-Wheeler Unit.—The Ford Motor Company has placed an order with the Crocker-Wheeler Company, of Ampere, N. J., for a 2500-kw, 250-volt generator. This machine will be gas-engine-driven at 85 r.p.m. Owing to the large dimensions attendant upon this rate of speed it has been decided to wind the armature of the machine at Detroit, since there is not sufficient railroad clearance to ship the machine in its finished state.

George Cutter and J. Lang Electric Company Consolidated.—A consolidation has been effected between the J. Lang Electric Company, of Chicago, and the George Cutter Company, of South Bend, Ind. The combined company is known as the George Cutter Company, and its main office and principal factory are in South Bend. The George Cutter Company was established in 1899 by George Cutter, who for many years previously had been one of the prominent electrical men of Chicago. It is one of the leading manufacturers of insulating and supporting devices for outdoor electric lamps. The J. Lang Electric Company was established in 1902, and it manufactured (as the George Cutter Company now manufactures) panelboards, switchboards, knife switches and distributing apparatus. Warren Ripple has been its president from the beginning, and the business has been successful. Its factory at 423 North Lincoln Street, Chicago, will be maintained as a branch factory. The George Cutter Company, by reason of this extension, has increased or will increase its capital stock from $120,000 to $500,000. The new officers are: President and general manager, Warren Ripple; vice-president, George Cutter; secretary and treasurer, R. S. Ripple. While Mr. Cutter will retire from the active supervision of business, he will give the company, in an advisory capacity, the benefit of his ripe judgment and long experience.

Los Angeles Aqueduct Hydroelectric Project.—The city of Los Angeles has recently approved a bond issue amounting to $357,367 to complete the equipment of the hydroelectric project which is to be operated in connection with the 250-mile aqueduct that brings the city water from Owens Lake near the Yosemite National Park. The general equipment will be installed at power house No. 1, located at San Franciscedo, 47 miles from Los Angeles, to which point energy is sent at 60,000 volts, and will consist of three 9375-kva, 6600-volt, 50-cycle, three-phase water-wheel generators running at 200 r.p.m.; two 250-kw, 250-volt direct-current water-wheel generators used as exciters; ten 3150-kva, single-phase, 50-cycle oil-insulated, water-cooled transformers for raising the generator voltage, 6600, to that of the transmission, 60,000. In the substation nine 5000-kva, single-phase, oil-insulated, water-cooled transformers for stepping down the transmission voltage to either 33,000 or 16,000 for secondary distribution will be installed. The entire equipment will be furnished by the Westinghouse Electric & Manufacturing Company.

Additions to Chicago Drainage Canal Hydroelectric Equipment.—Final settlement has been made by the Board of Trustees of the Sanitary District of Chicago with the W. A. Jackson Company for extensive additions to the hydroelectric system of the Sanitary District made in 1911. Six 4600-kw transformers were furnished and installed at a contract price of $16,000. Three of these were placed in the power house on the Drainage Canal at Lockport, Ill., and three in the Western Avenue terminal station in Chicago. The furnishing and installation of switchboard panels and oil switches in the power house cost $11,975, while the contract price for labor and material for generator and transformer connections was $1,900. The three contracts involved an expenditure of $29,875, but a deduction of $120 was made owing to default of time in completing some parts of the work.

Au Sable Plant Ready for Operation.—The Commonwealth Power, Railway & Light Company, of Jackson, Mich., of which A. G. Hoodenpyl, of Hodenpyl, Hardy & Company, 7 Wall Street, New York City, is president, has practically completed its 12,000-kw plant on the Au Sable River, about 15 miles above Au Sable, Mich. The company has completed its 135,000-volt transmission line from the Au Sable plant as far as Saginaw and Flint, and during the year will extend this through Owosso and Charlotte to Battle Creek. The company will build a steam station this year at Battle Creek, containing one 7500-kw unit. The Commonwealth company spent about $2,500,000 in Michigan in 1911 and plans to spend an equal amount this year.

San Joaquin Light & Power Company's Extensions.—Since the first of January, 1911, the San Joaquin Light & Power Company, of Fresno, Cal., has added 1000 miles of new power circuits to its system. These lines extend from Gustine, in the southern part of Stanislaus County, to Bakersfield on the south. Work is now being rushed by the company upon lines which will supply energy to pumping stations so that ranchers in its territory can get water in the dry season. Energy is now being supplied by the company to numerous orange and raisin growers and for general farming purposes.

Federal Sign System (Electric) Acquires Brooklyn Sign Company.—The sign department of the Metropolitan Engineering Company, of 1250 Atlantic Avenue, Brooklyn, has been purchased by the Federal Sign System (Electric), of 229 West Forty-second Street, New York City. A large part of the Metropolitan selling organization will become associated with the Federal system as a result of this change. The consolidation is virtually a merger of the selling organization of the Metropolitan with the renting organization of the Federal. The Metropolitan Engineering Company will continue to promote the Murray porcelain specialties.

H. W. Johns-Manville Company's New Factory to Be at Finderne, N. J.—The H. W. Johns-Manville Company, manufacturer of asbestos and magnesia coverings and electrical supplies, has acquired a tract of over 200 acres at Finderne, N. J., upon which it will erect a general Eastern factory. The output of this factory, as stated in these columns Dec. 16, 1911, will be sufficient to meet the entire demand for the company's products from this part of the country. The company will shortly move its executive office from 100 William Street, New York, to its new building at Madison Avenue and Forty-first Street, New York.

Crude-Oil Gas Producer.—The Wisconsin Engine Company, Corliss, Wis., is developing a crude-oil gas producer invented by Arthur Grine, of California, for which strong claims are made as to low cost and high efficiency. The producer is adapted to the use of the lowest grades of oil, and can be made in capacities, it is claimed, as high as 10,000 hp. Edward T. Adams, formerly chief engineer of the Allis-Chalmers Company, is now president of the Wisconsin Engine Company. Nisbet Latta, the author of several books on gas engines, is assitant to Mr. Adams.

Wagner Electric Manufacturing Company Elections.—The board of directors of the Wagner Electric Manufacturing Company, of St. Louis, Mo., has elected the following officers: S. M. Dodd, chairman; W. A. Layman, president and general manager; J. W. Bell, vice-president; Albert Blair, secretary; W. S. Thomas, treasurer; M. S. Allcorn and W. S. Thomas, assistant secretaries, and Walter Robbins, assistant general manager. Members of the board are: S. M. Dodd, W. K. Bixby, Thomas H. West, J. W. Bell, A. Blair, J. Campbell and W. A. Layman.

Isthmian Canal Proposals.—Circular No. 678 of the Isthmian Canal Commission invites proposals on three 300-kw, three-phase, 2200-220-volt, 25-cycle transformers. Bids for this apparatus will be received at the office of the commission, Washington, D. C., not later than 10:30 a.m. on Feb. 20, 1912.

Aluminum Notes and Prices.—Demand for aluminum is showing mild improvement, and prices are being held slightly firmer, as compared with conditions last week. Quotations Jan. 30 were 19@20 cents for ingots for remelting, in large lots, 31 cents for rods and wire, and 33 cents for sheets.

Financial.

Pacific Gas & Electric Bonds.—A block of $20,000,000 general and refunding mortgage 5 per cent gold bonds of the Pacific Gas & Electric Company, dated Dec. 1, 1911, and due Jan. 1, 1942, was offered this week by banking interests in New York, Boston and Chicago. A circular accompanying the offering states that the company was incorporated under the laws of California in 1905, and that in the extent and value of its properties and assets, in the area of its operation and in the magnitude of its revenue it ranks as one of the largest and most successful public-utility corporations in the United States. The territory which it serves comprises twenty-four counties in central California, embracing an area of approximately 33,000 sq. miles, in which are included San Fran-

cisco, Oakland, Berkeley, Alameda, San José, Sacramento, Fresno and Stockton. The company has $28,908,750 common stock outstanding and $10,000,000 preferred stock outstanding, and upon completion of the present financing, involving the immediate retirement of the $8,492,502 Pacific Gas & Electric Company 5's due Jan. 2, 1936, and the $4,000,000 Pacific Gas & Electric Company 6's due Dec. 15, 1937, its total bonded debt outstanding will be $71,912,000. This will be made up of the present issue of $20,000,000 general and refunding mortgage 5's and $51,912,000 underlying divisional bonds for the retirement of which a like amount of general and refunding 5's are reserved. The aggregate amount of the present underlying issues can never be increased. The proceeds of the present issue of bonds will be applied to the retirement of $12,492,502 of underlying bonds and to acquiring additional property, which will become subject to the lien of the general and refunding mortgage. In order to provide for the future financial requirements of the company, the authorized issue of general and refunding mortgage bonds has been increased to $150,000,000, as noted in these columns. Of this the present issue is $20,000,000. The unissued bonds are available to the extent of $51,912,000 for refunding the underlying issues and to the extent of $68,080,000 (to be issued under restrictions safeguarding the rights of outstanding bonds) for not exceeding 90 per cent of the cost of additions, betterments, extensions, etc., provided, however, the earnings available for bond interest are at least one and one-half times the annual interest on all outstanding bonds, including those to be issued, but excluding those held alive in sinking funds. The remaining aggregate of not exceeding $10,000,000 of bonds may either be issued under restrictions for the stocks and bonds of other companies, or else for betterments, etc., under the same restrictions governing the issuance of the $68,080,000 of bonds mentioned above. Issues of these bonds can be made after March 23, 1912, only with the approval of the California Railroad Commission, jurisdiction of which will extend on and after that date to all public service corporations operating in the State. Gross earnings of the company in the year ended Dec. 31, 1911 (with those for December partly estimated), were $14,682,669, and net earnings were $6,531,305. After payment of $3,278,177 bond interest there was left a balance of $3,253,128. The total generating capacity of the company's electric stations, including ratings of plants now under construction, aggregates 192,573 hp. The company has 3289 miles of overhead lines, 61 miles of underground lines and 105 substations. It also has 38 miles of street railway, sixteen gas plants, with a total daily capacity of 41,200,000 cu. ft., forty-nine reservoirs, with a capacity of 18,543,000,000 cu. ft., and 529 miles of irrigation canals, pipe lines, etc. Its franchises in municipalities, according to the circular, are unlimited as to time, and such county franchises as are necessary extend, with minor exceptions, beyond the maturity of the bonds.

Missouri Bell May Merge with American Telephone & Telegraph Company.—Stockholders of the Bell Telephone Company of Missouri, which operates in St. Louis and in several counties in Missouri and Illinois and is a subsidiary of the American Telephone & Telegraph Company, will hold their annual meeting in St. Louis on Feb. 20. They will vote at the meeting upon selling out to the American Telephone & Telegraph Company on a basis of seven shares of Bell stock for six shares of the parent company. The effect of this merger would be the ending of the differences that have existed between the St. Louis company and the American company since last October, when the American Telephone & Telegraph Company ordered a reduction in telephone rates throughout the city. This order was not carried out, as the American interests on the board were in the minority. It is stated that the special committee of the Bell company has reported favorably on the proposed merger.

Pacific Power & Light Bonds.—Bond houses are offering first and refunding mortgage gold 5 per cent bonds of the Pacific Power & Light Company, which is serving fifty communities and the surrounding country in the States of Washington, Oregon and Idaho. A circular describing the offering states that the company was organized in June, 1910, under the laws of the State of Maine, and is a result of the consolidation of various established properties and that its capitalization is as follows: First and refunding 5's, authorized $30,000,000, outstanding $5,295,000; 7 per cent cumulative preferred stock, authorized $3,500,000, outstanding $2,000,000; second preferred stock authorized, $2,500,000, outstanding $1,500,000; common stock authorized $6,000,000, outstanding $6,000,000. The first and refunding 5 per cent bonds are secured by a first and only lien on all the property of the company, which is as follows: (1) Electric-power stations having a capacity of approximately 20,735 hp, of which 13,300 hp is hydroelectric, additional hydroelectric capacity of 1650 hp being now under construction; (2) high-voltage transmission lines in operation, aggregating 444 miles; (3) a street railway in Astoria, Ore., a street railway in Walla Walla, Wash., and an interurban railway from Walla Walla to Freewater and Milton, Ore.; gas plants in Lewiston, Idaho, with an extension of the gas mains to Clarkson, Walla Walla and North Yakima, Wash., Pendleton and Astoria, Ore.; water-works in North Yakima, Prosser, Kennewick and Pasco, Wash., and Hood River, Ore. Net earnings of the company for the twelve months ended Nov. 30, 1911, were $557,577, which is more than twice the annual interest charges on all the bonds now outstanding. Additional bonds are issuable only for 80 per cent of cost of improvements and extensions, when net earnings for twelve months have been at least twice annual interest on all bonds outstanding and then to be issued. The franchises of the company are either unlimited as to time or extend for substantial periods beyond the life of the bonds. The bonds offered are dated Aug. 1, 1910, and are due Aug. 1, 1930. The entire common stock of the company is owned by the American Power & Light Company, controlled by interests associated with the Electric Bond & Share Company, which in turn is controlled through stock ownership by the General Electric Company.

Toledo Railways & Light Reorganization.—Representatives of the stockholders' protective committee of the Toledo Railways & Light Company, at a meeting between the bondholders' and stockholders' protective committees this week, expressed themselves as opposed to the proposed plan of the bondholders' committee for reorganization of the company. It is the belief of the stockholders' protective committee, of which W. E. Hutton is chairman, that it can draft a plan for reorganizing the finances of the company that will be more acceptable to the stockholders than that proposed by the bondholders' committee. The latter's plan calls for an assessment of about $7 a share on the stockholders.

Philadelphia Electric Merger Rumor Denied.—President McCall, of the Philadelphia Electric Company, after a directors' meeting Jan. 30 said, in connection with rumors that the Philadelphia Electric would be consolidated with the United Gas Improvement Company: "The board transacted only routine business. There has not been at any time before the directors any proposal of consolidation with the United Gas Improvement, nor has the subject been discussed by the board. As far as we are concerned, we know nothing about a merger."

Allis-Chalmers Reorganization.—The bondholders' protective committee for the first-mortgage 5 per cent ten-thirty-year sinking-fund gold bonds of the Allis-Chalmers Company held a meeting on Jan. 31 in New York. It was stated after the meeting that no reorganization plan had been decided upon as yet, and that the matter was going forward with as much dispatch as careful study would permit.

New Lighting Company Applies for Franchise in Baltimore.—An ordinance has been introduced in the City Council of Baltimore giving a franchise to the Patapsco Electric Light & Power Company to operate in Baltimore. The ordinance gives very liberal powers as regards the use of conduits and subways in the city.

MARKET PRICES.

	Jan. 24.	Jan. 31.		Jan. 24.	Jan. 31.
Allis-Chalmers	1¼	1¼	General Electric.....160	160	157
Allis-Chalmers, pf....	6⅛	8*	Mackay Companies...	75¾	75⅛
Amalgamated Cop....	64⅜	61	Mackay Cos., pf.....	70½	69
Boston Edison.....297		298	Philadelphia Elec.....	17⅝	18
C'monwealth Edison..138½		130	Western Union.....	83½	83
Elec. Storage Bty...	55	53¾	Westinghouse	74	70
Elec. Stor. Bty., pf.	30*	30*	Westinghouse, pfd....119¼*		119¼*

*Last price quoted.

Personal.

Mr. A. F. Blossey has resigned his position as superintendent of the Alton (Ill.) Gas & Electric Company.

Mr. L. E. Butler, of Evansville, Ind., has succeeded Mr. Elmer E. Crawford as manager of the Sterling (Ill.) Gas & Electric Light Company.

Mr. B. G. Tremaine, vice-president of the National Electric Lamp Company, of Cleveland, Ohio, has been elected a director of the Cities Service Company.

Mr. J. Brodie Smith has withdrawn his resignation from the Manchester Traction, Light & Power Company and will remain as vice-president and general manager.

Mr. George H. McCormack has resigned his position as sales manager and treasurer of the Opalux Company, New York, to take effect Feb. 10, 1912, in order to enter another line of business.

Messrs. Edward Quillan and C. T. Bowman have been transferred from the commercial department of the Easton (Pa.) Gas & Electric Company to the corresponding department of the Knoxville Gas Company.

Mr. C. E. A. Carr, formerly general manager of the Quebec Railway, Light & Power Company, Quebec, Canada, has accepted the position of general manager of the New Orleans Southern & Grand Isle Railway.

Mr. Godfrey H. Atkin, of Chicago, addressed The Milwaukee Electric Railway & Light Company Section of the National Electric Light Association, Jan. 25, on the subject of "The Electric Vehicle as a Factor in the Central-Station Business."

Mr. Charles E. Fahrney, formerly superintendent of the Ottumwa (Ia.) Railway & Light Company, has been made manager of the company, succeeding Mr. W. F. Raber, now manager of the Pueblo (Col.) & Suburban Traction & Lighting Company.

Mr. Alten S. Miller, formerly president and general manager of the Union Electric Light & Power Company, St. Louis, and a member of the consulting engineering firm of Humphreys & Miller, Inc., has been elected president of the Hyattsville (Md.) Gas & Electric Company.

Mr. George T. Hanchett, who for many years engaged in practice as a consulting electrical engineer in New York City, has retired from that line of work to become consulting engineer of the United States Motor Company, the New York office of which is at 3 West Sixty-first Street.

Mr. E. Eysenbach has resigned as vice-president and general manager of the Consolidated Gas Company, which controls the electric-lighting business in Long Branch, N. J. A dinner was tendered to Mr. Eysenbach and his successor, Mr. Fred R. Cutcheon, by the officers and employees of the company on Jan. 20.

Mr. William Stewart, who has been connected with the Washington, Baltimore & Annapolis Electric Railroad, Baltimore, Md., as secretary to the general manager, has been elected secretary and treasurer of the Newport News & Old Point Railway & Electric Company. Mr. Stewart's headquarters will be at Hampton, Va.

Mr. Mortimer Silverman has resigned his position as electrical engineer of the Western New York & Pennsylvania Traction Company, Olean, N. Y., which interests also control the Olean Electric Light & Power Company, and has accepted that of electrical engineer of the Fort Dodge, Des Moines & Southern Railroad, with office at Boone, Ia.

Mr. M. N. Webster, of the St. Paul Gas Light Company, gave a talk on flaming-arc lamps on Jan. 22 before the St. Paul Gas Light Section of the National Electric Light Association. St. Paul, which has just completed installing 300 long-hour-burning inclosed flaming arc lamps, claims to be the first city in this country to adopt this type for general street lighting.

Mr. B. H. Gardner has resigned his position as contract agent of the Dayton (Ohio) Power & Light Company to become sales manager of the United Electric Light & Water Company, Waterbury, Conn. Mr. Gardner's successor will be Mr. J. C. Matthieu, who has been motor-service engineer with the Dayton Power & Light Company for about two years.

Mr. George J. Henry, Jr., who has been eighteen years with the Pelton Water Wheel Company, of San Francisco and New York, during the last ten of which he has been the company's chief engineer and during the past six chief engineer and sales manager, has resigned to open an engineering office in the Rialto Building, San Francisco. Mr. Henry will engage in work of every kind relating to the design and equipment of hydraulic plants.

Mr. F. A. Swan, of the Swan Electric Company, 37 Pearl Street, Boston, Mass., has dedicated to the public a number of electrical patents, and also applications for further patents. The patents are six in number, issued in 1908, 1909 and 1910, and relate to electrical fittings and strain reliefs for fittings. The applications, five in number, were filed in 1909 and 1910 and relate to strain reliefs, rosettes, pendent lamp socket and cord adjuster. The act of dedication is dated Dec. 30, 1911.

Mr. Fred G. Dustin, chief electrical inspector of the Minneapolis Department of Buildings, was one of the organizers of the Minneapolis Electric Club, whose plan of monthly meetings and other of its methods have been adopted in several cities in the Northwest. Mr. Dustin is president of the club and is also at the head of the Northwestern Electrical Show Association, which will hold a co-operative electrical show in Minneapolis in March. As chief inspector for Minneapolis, Mr. Dustin is also past-president of the Western Association of Electrical Inspectors.

Prof. Elihu Thomson delivered a lecture on Jan. 23 before the Schenectady Section of the American Institute of Electrical Engineers entitled "A Hunt for a Great Meteor and Its Lesson." Prof. Thomson described in detail a great crater near Canyon Diablo in Arizona, about three-quarters of a mile in diameter and over 600 ft. deep, which was made by a meteor that struck the earth some thousands of years ago. From an examination of this meteor, Prof. Thomson found facts which, he believes, indicate that the moon spots are not of volcanic origin, as held by some astronomers, but are due to the impacts of meteors.

Mr. Williston Fish, long assistant to President John M. Roach of the Chicago Railways Company, has been elected a director and vice-president of the company. Mr. Fish graduated from the United States Military Academy at West Point in 1881. After serving in the army for several years he studied law and was admitted to the bar in Chicago in 1893. He became interested in street-railway enterprises first as a legal adviser, and for a number of years has been connected with the Chicago Union Traction Company and its successor. Mr. Fish has a taste for literature, and one of his pieces, "A Last Will," has been widely read and greatly admired for its beautiful imagery.

Mr. Roy Mason, well known in newspaper and publishing circles, has been appointed advertising manager of the Crocker-Wheeler Company, of Ampere, N. J. Mr. Mason graduated from Yale College in 1902, receiving the degree of Bachelor of Arts, after which he spent a year in a ranching venture in Vera Cruz. He began his literary career in 1903 as a reporter on the New York *Sun*, resigning early in 1905 to become advertising manager for D. Appleton & Company. In 1907-8 he was in charge of the financial advertising department of the New York *Times*. Later he was in the advertising and publicity department of *Everybody's Magazine*. He also served in 1911 as one of the editors of the "Photographic History of the Civil War," pulished by the Review of Reviews Company. Mr. Mason is the author of a novel entitled "When I Am Rich," published by G. W. Dillingham & Company.

Mr. J. Warren Young has resigned as chief signal inspector of the Erie Railroad Company to take a position with the Kerite Insulated Wire & Cable Company, 30 Church Street, New York City. Mr. Young was born in New York City on Nov. 3, 1877, and after receiving a public school education entered the service of the Central Railroad of New Jersey in April, 1896, as signal maintainer's helper, remaining with that company until November, 1899, when he resigned to take a position with the Delaware, Lackawanna & Western Railroad as maintainer and inspector of signals. Later he went with the New York, Sus-

quehanna & Western Railroad to take charge of its signal work. In September, 1904, he was appointed supervisor of signals of the terminal division of the Erie Railroad, and in November, 1905, was appointed signal inspector in the signal engineer's office, which position he held until Jan. 1, 1907, when he was promoted to the position of chief signal inspector. Mr. Young has been a member of the Railway Signal Association for ten years and for the past five years has served on Committee No. 9 (wires and cables) of the association.

Mr. Waldo Arnold Layman, general manager of the Wagner Electric Manufacturing Company, St. Louis, since 1902, and vice-president since 1908, has been elected president of the company to succeed Mr. S. M. Dodd, who has been chosen chairman of the board of directors. Mr. Layman graduated from the Rose Polytechnic Institute with the degree of B.S. in 1892 at the age of twenty-three. He was given the degree of M.S. in 1894 and the degree of E.E. in 1899 by the same college. Previous to graduation Mr. Layman served on the editorial staffs of the Terre Haute (Ind.) *Daily Express*, the Terre Haute *Saturday Evening Mail*, a monthly college paper and the college year book at the Rose Polytechnic Institute. Shortly after graduation in 1892 he entered the employ of the company of which he is now president as a utility man in testing and drafting work. In 1894 he became assistant superintendent and in 1898 the position of assistant general manager of the company was given to him. In 1900 he became treasurer and was later made general manager, vice-president and president as noted above. Mr. Layman has served as president of the Engineers' Club of St. Louis and the St. Louis Metal Trades Association and is a member of a large number of St. Louis clubs. He has been a member of the American Institute of Electrical Engineers since 1900.

Mr. J. N. Shannahan has resigned as railway manager of the operating department of J. G. White & Company, New York, to become vice-president and general manager of the Newport News & Old Point Railway & Electric Company, Newport News, Va., which has been taken over by Allen & Peck, Inc. Mr. Shannahan will also represent Allen & Peck in the Southern territory, with Old Point as a center. Before becoming connected with J. G. White & Company, Inc., Mr. Shannahan was vice-president and general manager of the Washington, Baltimore & Annapolis Electric Railway. Mr. Shannahan is a native of Troy, N. Y., where he was born in 1872. He was graduated from the Rensselaer Polytechnic Institute in 1894 as civil engineer. After a short connection with the Watervliet arsenal of the government he entered the service of the New York Central & Hudson River Railroad in the signal department, and on July 1, 1895, was appointed inspector of signals on the western division of that company. In 1899 he accepted the position of chief engineer of the Fonda, Johnstown & Gloversville Railroad, and in 1903 was made general superintendent of the company, with jurisdiction over the company's steam and electric properties. At the same time he was general manager of the Edison Electric Light & Power Company at Amsterdam, N. Y. In 1904 he was also elected president of the Adirondack Lakes Traction Company. On July 1, 1907, he severed all these business connections to become vice-president and general manager of the Washington, Baltimore & Annapolis Electric Railway. While connected with the New York State properties Mr. Shannahan was elected president of the Street Railway Association of the State of New York and occupied this office during the year 1906-7. During the years of 1907-8 and 1908-9 he served as chairman of the committee on interurban rules of the American Railway Transportation & Traffic Association, and at the last annual meeting was elected first vice-president of that organization.

Mr. Frank F. Fowle, of Chicago, will join the staff of the *Electrical World* on Feb. 15 as associate editor. Mr. Fowle graduated from the electrical engineering course of the Massachusetts Institute of Technology in 1899. From 1899 to 1903 Mr. Fowle held the position of assistant engineer in the long-distance department of the American Bell Telephone Company, during which time he made theoretical and experimental investigations relating to telephonic transmission, designed power plants for toll offices, conducted commercial tests of motors, generators, dynamotors, oil engines, etc., and did extensive work in connection with the development and application of the Pupin system of loading. From 1903 to 1906 he held the position of special agent of the railway department, his work consisting in introducing the railway composite system among the steam railroads and acting in an advisory capacity to steam roads in matters relating to telephone operation and construction, the preparation of plans and specifications, analyses of costs and rate systems, the development of special equipment for railway telephone service, etc. From 1906 to 1908 he held the position of manager of the long-distance system in the Chicago Bell territory, during which he gave particular attention to problems of organization, traffic and maintenance. From 1908 until the present Mr. Fowle has practised in Chicago as a consulting electrical engineer, his activities extending over a wide range of work, including appearance before the Wisconsin Public Service Commission as an expert on central-station rates and service, the analysis of isolated plant economy, investigation of electrolysis of water mains, appraisal of telephone properties, investigation of disturbance to telephone lines from high-tension currents, theoretical and experimental study of composite conductors, assistance in the development of an evaporative type of condenser for steam-power plants, reports on street lighting and on central-station service, etc. Mr. Fowle has contributed largely to the proceedings of engineering societies and to the technical press, his papers and articles, as a rule, giving the result of original investigations and studies.

Obituary.

Mr. Edwin Hawley, well known in financial and railroad circles, died at his home in New York City on Feb. 1 from heart disease. Mr. Hawley was born in Chatham, N. Y., in 1850, and since the death of Edward Harriman was looked upon as the foremost railroad reconstructor of the country. His activities were not devoted entirely to railroads, however. Until very recently he was president of the Great Western Power Company, the California Electric Generating Company, and also of the Western Power Company, as well as vice-president of the U. S. Light & Heating Company. In addition to these lighting properties Mr. Hawley was interested in electric railways, notably the Interborough Rapid Transit Company and the Interborough-Metropolitan Company. He was a member of the firm of Hawley & Davis, New York.

Mr. George Schuyler Davis died in Cleveland, Ohio, on Jan. 24, 1912. Mr. Davis was well known in electric railway circles throughout the country by reason of his connection with various electric railway publications, being at the time of his death editor of *Electric Traction Weekly*, of Chicago, Ill. He was born in Wellington, Ohio, Aug. 28, 1875, and soon after his parents moved to Cleveland, where all of his life, with the exception of a few years, was spent. His early education was received in the Cleveland public schools. In 1894 he entered the employ of the *Cycling Gazette*, of Cleveland, and he continued with that publication in an editorial capacity until 1900. He then became associated with several of the leading automobile papers as Cleveland representative. About this time he also became regular correspondent to a number of technical publications, including the *Street Railway Journal*, of New York City. This was the time of the great development of the electric railways in the Middle West, particularly in Ohio. This industry demanded more and more of Mr. Davis' time and efforts and in the fall of 1907 he became financially interested in *Electric Traction Weekly*, with which he was ever since identified in an editorial as well as a business way. At first he was associate editor, but for several years he had directed the affairs of the paper as editor. He was also vice-president and secretary of the Kenfield-Davis Publishing Company. Mr. Davis was one of the charter members of the Central Electric Railway Association and an associate member of the American Electric Railway Engineering Association.

Construction.

ASHLAND, ALA.—The Ashland Oil Mill & Fertilizer Co. is planning to install an electric-light plant.

LITTLE ROCK, ARK.—The Arkansas Valley Inter. Ry. Co. has awarded the contract for construction of a substation in Rocky Ford to the Rocky Mountain Cement Co.

BAKERSFIELD, CAL.—The Southern Sierras Pwr. Co. contemplates extending its transmission line from Randsburg to Barstow, Cal.

CORONA, CAL.—The Pacific Lt. & Pwr. Co., Los Angeles, Cal., has applied to the City Trustees for a franchise to erect transmission lines and conduits for the distribution of electricity in the city.

CORONA, CAL.—Application has been made to the City Trustees by the Southern Sierras Pwr. Co. for a franchise to erect a transmission line through the city in order that it may reach the pumping plants of the National Orange Co. on Orange Heights and the Temescal Wtr. Co. in the canyon.

EL CENTRO, CAL.—The property of the People's Lt. & Power Co. has been acquired by the Holton Pwr. Co., which is planning extensions to its transmission lines.

FRESNO, CAL.—Preliminary arrangements are being made for the erection of the double-tower transmission line from Big Creek to Los Angeles by the San Joaquin Lt. & Pwr. Co.

GLENDALE, CAL.—Application has been made to the City Council by E. D. Goode, of San Fernando, Cal., for a franchise for an electric railway to connect Glendale with Griffith Park.

HEMET, CAL.—The Sierras El. Lt. & Pwr. Co. has applied for a 50-year franchise to erect and operate an electric light and power system here. The company, it is said, has submitted a proposition to W. F. Whittier to purchase the electric plant owned by the Hemet Milling & Pwr. Co.

LOS ANGELES, CAL.—The Pacific Lt. & Pwr. Co. has taken out a permit to build an addition to its plant on Central Avenue.

MODESTO, CAL.—The Board of County Supervisors has granted the Sierra & San Francisco Pwr. Co. a franchise to erect and maintain an electric transmission line in certain parts of Stanislaus County.

MONTEREY, CAL.—The Monterey & San Joaquin Ry. Co. has been organized to take over the railway of the Monterey & Del Monte Heights Ry. Co., 3 miles in length, and extend it into the San Joaquin Valley. William Sandholdt and T. A. Work are interested.

NEVADA CITY, CAL.—The City Trustees have decided to ask the Pacific Gas & El. Co. to place a valuation on its power house at Rome, which has been dismantled and abandoned by the company, with a view of establishing a municipal electric plant. It is proposed to submit a proposition to the trustees of Grass Valley for joint ownership of the plant to supply electricity to both cities.

PASADENA, CALL.—An electrolier lighting system will be installed on South Orange Avenue, at a cost of about $34,000.

PASADENA, CAL.—The Southern Pacific Co. has applied to the City Council for a franchise to equip its system for electrical operation from the Southern Pacific depot to the city limits.

PLYMOUTH, CAL.—An electric plant is being installed at the Empire and Pacific Mines. J. F. Parks is superintendent.

PORTERVILLE, CAL.—Right-of-way is being secured for the proposed tower transmission line of the Pacific Lt. & Pwr. Co., of Los Angeles, from its plants on Deer Creek, east of Porterville, to Los Angeles, a distance of 280 miles. A branch line will be erected later from this city to Fresno. The cost of the proposed line is estimated at $1,000,000.

SAN BERNARDINO, CAL.—A movement is on foot among the Mojave River valley towns to induce the Southern Sierras Power Company to erect a branch line from its main transmission line, either at Hinkley or Victorville, making a loop among the river points to provide electricity to operate the pumping plants and for lamps.

SAN FRANCISCO, CAL.—The contract for construction of an administration building, power plant and laundry for the Odd Fellows' Home, near San Jose, has been awarded to J. C. Hurley, at $17,904.

SAN JOSE, CAL.—Bids have been called for by the Market Street Improvement Association for 96 electroliers for street lighting on Market Street.

SANTA ROSA, CAL.—The California Tel. & Lt. Co., which owns the Russian River Lt. & Pwr. Co. and the Sonoma Valley Lt. & Pwr. Co., has completed arrangements with the Pacific Gas & El. Co., of San Francisco, for electricity to be distributed throughout Sonoma County. Surveys will be made at once by the California Tel. & Lt. Co. for large extensions to both its light and telephone systems. Fred L. Wright is president of the California company.

STOCKTON, CAL.—The City Council has passed a resolution calling for a bond election for the new electrolier-lighting system. C. L. Corey has been engaged as consulting engineer to prepare plans for the lighting system.

STOCKTON, CAL.—The Stockton & Southern R. R. Co. has awarded a contract for the construction of its railway from Stockton to Turlock, via Modesto and Ceres, a distance of 50 miles, to the Daae Construction Co., Sacramento. J. H. Wallace, Stockton, is chief engineer.

VALLEJO, CAL.—Surveys are being made by the Great Western Pwr. Co. for the erection of a transmission line through the center of Solano County, starting from Rio Vista, where the line will cross the Sacramento River, and continuing through Suisin and across Green Valley to Napa, Petaluma and Santa Rosa.

YUBA CITY, CAL.—The Pacific Gas & El. Co. is extending its transmission lines through the southern part of Sutter County. Electricity will be furnished to the towns of O'Bannion, Tudor, Oswald and Harkey and intervening territory.

BOULDER, COL.—Preliminary estimates have been submitted by Prof. Evans, of the electrical engineering department of the State University, to the City Council on the proposed municipal electric-light plant. The cost of the plant is estimated at about $78,000 and the cost of maintenance is placed at about $14,600 per year.

GRAND JUNCTION, COL.—Arrangements are being made for the construction of an interurban railway across the Grand River to the Redlands and thence 7 miles to the National Monument Park. Enos Miller and others are interested.

PAONIA, COL.—A new 100-kw alternating-current generator and engine will be installed in the municipal electric-light plant about April 1. A day service will be established about March 1. Series tungsten street lamps are now being erected. W. R. Jewell is superintendent.

ZEPHYR HILLS, FLA.—Plans are being considered for the installation of a new electric-light plant here. Francisco & Son are interested.

AMERICUS, GA.—The Americus Gas & El. Co. has applied to the Georgia Railroad Commission for permission to issue $250,000 in capital stock and $300,000 in bonds for extensions and improvements.

ATLANTA, GA.—The Atlanta & West Point R. R. Co. will soon place the contract for equipment for a telephone system for train dispatching, to cost about $30,000.

ATLANTA, GA.—The Merchants' Co. is being organized for the purpose of installing a 200-kw electric-light plant to supply electricity for four large department stores and later to supply electrical service to others in the vicinity. The cost of the plant is estimated at $30,000.

ATLANTA, GA.—The Central Georgia Pwr. Co. has submitted plans to the city electrician for the proposed substation to be erected in Atlanta, at a cost of $85,000. For the present the company, it is said, will sell power to large consumers only. W. J. Massee, of Macon, is president.

CARROLLTON, GA.—S. D. Brown, Carrollton, would like to receive prices on a 250-kw, three-phase, 60-cycle, 220-volt second-hand, direct-connected generating unit.

COLUMBUS, GA.—The Columbus R. R. Co. contemplates extending its electric system. John S. Bleecker is manager.

DALTON, GA.—The city is now securing prices for the installation of another unit in the municipal electric-light plant and is also negotiating with the Eastern Tennessee Pwr. Co., Parksville, Tenn., and the North Georgia El. Co., Gainesville, to deliver energy at the city switchboard for street and commercial lighting on a long-term contract. An additional unit will be installed even if the contract is made, as the city pumping station is operated by electric motors. C. C. McCamy is general superintendent.

HELENA, GA.—The Council has awarded the contract for the construction of the municipal electric-light plant to J. B. McCrary & Co., of Atlanta, Ga.

LA GRANGE, GA.—The Chamber of Commerce of La Grange is considering plans for the construction of an electric railway between West Point and Lanett, Ala., southwest of La Grange, and to Hogansville and Newman, to the northeast.

MACON, GA.—Bids will be received by W. H. Fetner, chairman Board of Water Commissioners, until Feb. 21 for furnishing two 75-hp, three-phase, 60-cycle, 550-volt induction motors, for direct connection with compensators for starting same; two 500-hp, 6600-volt, three-phase, 60-cycle induction motors for direct connection with controllers for starting same: four 40-kva, 6600-550-volt, three-phase, 60-cycle, oil-cooled transformers: switchboard; low-service, single-stage centrifugal pumps, each to be direct-connected to electric motor, each pump to have a capacity of 4500 gal. per minute; two high-service multi-stage turbine pumps, each to be direct-connected to an electric motor, each pump to have a capacity of 4500 gal. per minute; 145 fire hydrants; 4 24-in., 10 20-in., 2 14-in., 2 16-in., 15 12-in., 11 10-in., 25 8-in. and 124 6-in. iron-body, bronze-mounted gate valves.

BOISE, IDAHO.—The Mountain States Tel. & Teleg. Co. is planning to make improvements to its local system, to cost about $300,000.

CANTON, ILL.—The Canton Gas & El. Co. is contemplating enlarging its plant, at a cost of $50,000, this year.

CENTRALIA, ILL.—A committee has been appointed by the Commercial Club to raise $20,000 for the purpose of building an electric railway from Centralia to No. 5 Mine and the terminal yards of the Illinois Central Railroad. C. A. Glore, F. Kohl, E. A. Hartman and others are members of the committee.

CHAMPAIGN, ILL.—The University of Illinois has awarded a contract to the Urbana & Champaign Ry., Gas & El. Co. to furnish electricity to light the university.

EAST ST. LOUIS, ILL.—The East St. Louis & Suburban Ry. Co. has notified the City Council that it will apply for a franchise to erect and

maintain electric transmission lines on Twenty-third Street from Missouri Avenue to Bond Avenue.

LA SALLE, ILL.—Bids will be received by the City Council until Feb. 6 for equipment for the municipal electric-lighting plant as follows: One alternating-current, three-phase, 60-cycle generator, one exciter, three 35-kva constant-current regulating transformers to supply 70 flaming-arc lamps of 10-amp rating; one generator and exciter switchboard containing automatic oil switch, three alternating-current ammeters, alternating-current voltmeter with plug receptacle and potential transformers, field discharge switch, combination generator and exciter rheostat operating mechanism, etc.; one standard arc lamp switchboard for three circuits and 125 alternating-current flaming-arc lamps of 10 amp. including absolute cut-out.

LITCHFIELD, ILL.—The City Council has voted to enter into a contract with the United Gas & El. Co. for lighting the streets of the city for a period of five years. The company contemplates the installation of additional boilers.

COLFAX, IND.—The citizens are contemplating the installation of an electric-light system here. A proposition has been submitted to the City Council of Frankfort asking that city to supply electricity from its municipal electric plant to operate the system. The town of Colfax offers to bear the expense of erecting the transmission line between the two places.

DECATUR, IND.—Contract has been awarded to the Ft. Wayne Electric Works for 50 magnetite arc lamps. Fifty more will be purchased about July 1, 1912. M. J. Mylott is manager of the municipal electric plant.

ELKHART, IND.—The erection of a $10,000 power plant to supplement the 380-hp steam and water plant at the Elkhart Bristol Board and Paper Mill is contemplated by Cyrus E. Fry. It is proposed to erect a power house at Christiana Creek and install a water-wheel and a 125-kw to 200-kw generator.

INDIANAPOLIS, IND.—The General Industrial Mfg. Co., recently incorporated with a capital stock of $1,000,000 to manufacture machinery, engines and specialties of all kinds, proposes to install an electric plant to operate its plant and will dispose of its surplus energy. A large plant will be erected in this city. Thomas B. Laycock, Charles E. Coffin, W. J. Mooney, I. N. Richie and Edward W. Bowen are incorporators.

LINTON, IND.—A 300-kw, three-phase Allis-Chalmers generator, direct-connected, is being installed in the municipal electric-light plant. As soon as completed a 24-hour service will be established. The commercial distributing service will be changed from 1100 volts to 2300 volts. Extensive improvements will be made to the street-lighting system. W. R. Maddex is manager.

LYNN, IND.—The Town Board has decided to install an electric plant to supply electricity for lamps and motors for the city.

NEWCASTLE, IND.—Work will begin on improvements to the municipal electric-light plant and water-works system as soon as the weather will permit. The work will include the installation of new pumping machinery, new mains and considerable electrical apparatus. Plans were prepared by Charles Brassman, engineer, Indianapolis, Ind.

NEW HARMONY, IND.—Plans are being considered for the installation of a new street-lighting system, using series tungsten lamps, in the spring. P. M. Whittaker is superintendent of the municipal electric plant.

ALTON, IA.—The Council has granted Matthew Faber, of Remsen, a franchise, subject to approval of the voters, to install an electric-light plant in Alton.

ALTOONA, IA.—The Straight El. Co., of Altoona, has been granted a franchise to build and operate an electric-light plant here.

ALTOONA, IA.—A franchise has been granted to George T. Gibson to erect and maintain an electric-light plant here. Work will begin at once on the plant.

COGGON, IA.—Contracts have been awarded for the installation of a municipal electric-light plant in Coggon. It is proposed to erect ornamental street lamps on Main Street.

ELDORADO, IA.—At a recent election the voters approved a proposition to grant a franchise for the installation of an electric-light plant in the city. A contract for street lighting will probably be awarded in the spring.

EMERSON, IA.—At an election held Jan. 23 the proposition to establish a municipal electric-light plant was carried. C. L. Drill is town recorder.

MANSON, IA.—The property of the Manson El. Lt. Co. has been purchased by Omer Healey, of Corpus Christi, Tex., who, it is said, will make improvements to the plant.

MITCHELLVILLE, IA.—George T. Gibson has been granted a franchise to construct and operate an electric-light and power plant here.

MORNING SUN, IA.—The Council has granted P. A. Yohe a franchise to build and operate an electric-light, power and heating plant.

ATCHISON, KAN.—Mayor C. D. Walker and the Council have decided to establish a municipal electric-light plant. The maximum rate for electricity will be 8 cents per kw-hour.

CLAY CENTER, KAN.—Plans are being prepared for the installation of a new street-lighting system here. Incandescent lamps will be used in the residence portion of the city and arc lamps in the business district. C. F. Rasmussen is superintendent of the municipal plant.

EMPORIA, KAN.—The Emporia Tel. Co. has been granted permission by the Public Utilities Commission to issue $100,000 in bonds to take up outstanding indebtedness and for improvements. Part of the fund, it is reported, will be used for the erection of a new toll line between Emporia and Topeka.

MILDRED, KAN.—Preparations are being made for the installation of an independent electric-light plant for this town.

LOUISVILE, KY.—The Louisville Ry. Co. is planning to erect a supplemental power plant to be located on the Louisville & Portland canal in the northwestern section of the city. Two 500-kw steam turbine units will be installed with necessary boilers and auxiliaries. The building will provide space for two more units of approximately 10,000 kw. Alternating-current, three-phase, 25-cycle, 13,200-volt current will be generated and distributed to the nine substations of the company. Two 2000-kw rotary converters will be installed to furnish direct current for the electric railways in the vicinity of the plant.

MIDDLETOWN, KY.—The installation of a municipal electric-light plant here is under consideration.

BALTIMORE, MD.—The contract for installing cables to transmit electricity from the new pumping station on South Street to the city hall and other municipal buildings has been awarded to the Standard Underground Cable Co., Pittsburgh, Pa., for $10,915.

BALTIMORE, MD.—The Baltimore County El. Co. has petitioned the Public Service Commission for permission to acquire the electric property of the Baltimore County Wtr. & El. Co., for $371,000. Albert H. Wehr is general manager of the Baltimore County & El. Co.

TOWSON, MD.—Sealed proposals will be received at the office of the County Commissioners, Towson, Md., until Feb. 14 for furnishing arc and incandescent lamps for street lighting in Catonsville and surrounding territory. E. Stanton Bosley is chief clerk.

GRANBY, MASS.—A bill has been presented to the Legislature which provides for the incorporation of the Granby Wtr. Co. for the purpose of developing the Aldrich Mills property to generate electricity for lamps, heat and motors in Granby and Belchertown.

MANOMET, MASS.—The Plymouth & Sandwich St. Ry. Co. is planning to build an extension from Plymouth to Sagamore, a distance of 11 miles, during this year.

MILFORD, MASS.—The Milford & Uxbridge St. Ry. Co. is planning to extend its railway to Manchaug and East Douglas.

WINCHENDON, MASS.—The Winchendon El. Lt. & Pwr. Co. contemplates making some changes to its plant. F. W. Nourse is treasurer.

GRAND RAPIDS, MICH.—The property of the Grand Rapids, Grand Haven & Muskegon Ry. Co. has been purchased by the United Rys. & Lt. Co. Richard Schaddelee is president of the United company.

GRAND RAPIDS, MICH.—Plans and estimates have been submitted by Samuel A. Freshney, manager of the municipal electric-light plant, for the installation and maintenance of an ornamental street-lighting system in the business district. The plan calls for the installation of 182 ornamental lamp standards carrying five lamps, to cost about $120 each, making the total cost $21,840. The annual cost of maintenance is estimater at $10,082. It is proposed that the merchants and property holders shall pay for the installation of the system and the city maintain the same.

HOLLAND, MICH.—The installation of a new 1000-kva steam turbine and a 300-hp boiler in the municipal electric-light plant is contemplated during the coming year. R. B. Champion is manager.

SOUTH LYON, MICH.—A proposition to issue $3,500 in bonds to purchase new equipment for the municipal electric plant will be submitted to the voters at the spring election. B. A. Odell is manager.

SPARTA, MICH.—The Council has decided to call an election on Feb. 5 to vote on the proposition to grant the Grand Rapids-Muskegon Pwr. Co. a franchise to supply electricity in Sparta. The company asks for a 30-year franchise and if granted proposes to furnish electricity to other towns in this vicinity.

DEER RIVER, MINN.—The Everton El. Lt. & Pwr. Co. expects to install a 150-hp gas engine and producer and a 100-kw, 220-volt generator during the coming summer. W. A. Everton is owner and manager.

MADELIA, MINN.—It is reported that the citizens have voted to discard the present electric-light plant and secure electricity from the Rapidan power plant.

SAUK CENTER, MINN.—The Central Minnesota Pwr. & Millling Co. will install a 100-kw alternating-current, three-phase, 60-cycle General Electric generator about March 1. When completed a 24-hour service will be established for lamps and motors. S. T. Merryman is secretary and manager.

VERNDALE, MINN.—Plans are being considered for rebuilding the local electric-light plant, which was recently burned. H. M. Hicks is owner.

BEVIER, MO.—The City Council contemplates issuing bonds for municipal improvements, including the purchase of an electric-light plant recently installed by the Commercial Club.

JEFFERSON CITY, MO.—The capital stock of the Kansas City, Clay County & St. Joseph Ry. Co. has been increased from $720,000 to $1,000,000.

KANSAS CITY, MO.—Sealed proposals will be received by the Board

of Public Works until Feb. 23 for furnishing and installing a 2-ton electric-locomotive jib crane on the municipal wharf, having a maximum radius of 35 ft, with 1500 lb. capacity. For further information address the assistant city engineer.

SMITHVILE, MO.—The Smithville El. Lt. Co. is planning to install an ice plant, to cost about $5,000, in the spring. A. C. Morton is secretary.

TARKIO, MO.—The proposition to issue $27,000 in bonds for the purchase of the electric plant and water-works system of the Tarkio El. & Wtr. Co. will be submitted to a vote. At the same time the city will vote on the proposition to enter into a contract with the company for a renewal of the contract for electrical and water service.

KEARNEY, NEB.—The City Council has decided to call a special election to vote on the proposition to issue $40,000 in bonds to establish a municipal electric-light plant.

ELKO, NEV.—The Elko Lt. & Wtr. Corpn. is contemplating changing its plant from the direct-current to the alternating-current system. T. J. Critchley is manager.

GARDNERVILE, NEV.—Application has been made to the County Commissioners by William Scheele and Richard Thran for a 25-year franchise to operate an electric-light plant and transmit electricity along the county roads. Bids for the franchise will be received until March 4 at the office of the board at Genoa, Nev.

PATERSON, N. J.—Preliminary steps have been taken by the executive officers of the different municipalities in the county toward the construction of an electric-light plant to supply electricity for lighting the county roads. The proposed plant is to be owned and operated by the county.

DEMING, N. M.—The Producers' Pwr. Co. has purchased equipment for a 350-hp electric plant, which will be located in Deming. The company proposes to supply electricity to farmers to operate pumping plants for irrigating purposes. Dr. J. M. Williams and R. C. Ely are interested.

ALBANY, N. Y.—A bill has been introduced in the State Legislature by Senator White, of Schenectady, providing for lighting state and county highways by electricity. An appropriation of $25,000 is provided with which the State Highway Commission is to make a test of the feasibility of lighting improved roads either at the state or county expense. The experiment is to be tried on a strip of roads 10 miles long, but no specific road is designated.

COHOCTON, N. Y.—The Town Board of Trustees has granted the Wayne Pwr. Co. a franchise to construct and operate an electric-light plant. The company contemplates the erection of a central power plant, possibly in Cohocton, to supply electricity in the towns of Naples, Cohocton and Avoca. G. R. Mills, of Sodus, represents the company.

NEW YORK, N. Y.—The Public Service Commission has directed the Interborough Rapid Transit Co. to install storage batteries in all the subway cars to furnish an emergency lighting system in case of stalling of cars and cutting off of power.

NORWOOD, N. Y.—Arrangements are being made by the Norwood El. Lt. & Pwr. Co. to establish a 24-hour service in Norwood and Norfolk, beginning March 20. Orders have been placed by the company for a 350-hp engine and two new boilers. The company will also supply electricity for motors.

WAPPINGERS FALLS, N. Y.—The Garner Print Works & Bleachery, of Wappingers Falls, has been granted a franchise to erect pole lines and conduits to furnish electricity here. The company will also extend its lines to Hughsonville and New Hamburg to supply energy for street and commercial lighting.

WARWICK, N. Y.—The Public Service Commission, Second District, has issued an order requiring the Warwick Valley Lt. & Pwr. Co. to improve and repair its distributing system in Warwick.

CHARLOTTE, N. C.—The Charlotte El. Ry., Lt. & Pwr. Co. is contemplating building an extension to the Mecklenburg Country Club.

DURHAM, N. C.—A company is being organized to distribute electricity to be taken from the transmission lines of the Southern Pwr. Co., of Charlotte. George L. Lyon is interested.

ELIZABETH CITY, N. C.—The electric plant of the Elizabeth City El. Lt. Co. was damaged by fire recently.

GASTONIA, N. C.—The Council contemplates submitting the proposition to issue $5,000 in bonds for improvements to the municipal electric-light plant to a vote.

KENILWORTH, N. C.—The Kenilworth Development Co. proposes to erect an electric-light plant in connection with the club colony which it intends to establish. J. M. Chiles, of Asheville, is interested Kenilworth has not a post office.

LITTLETON, N. C.—Bids will be received by the city of Littleton until Feb. 15 for the construction of a municipal electric-light plant, for which bonds to the amount of $10,000 have been issued. T. J. Miles is Mayor and C. E. Fairbanks, American National Bank Building, Richmond, Va., consulting engineer.

RAY, N. D.—The installation of an electric-light plant in Ray is under consideration. Sidney J. Dorothy, of Williston, and Frank B. Dorothy, of St. Croix Falls, Wis., are interested.

BRYAN, OHIO.—The City Council has passed an ordinance authorizing a sale of $17,000 in bonds to provide additional funds to enlarge the municipal electric-light plant. An issue of $23,000 was authorized late in 1911, which with the last issue will make $40,000 available for improvements.

CLEVELAND, OHIO.—The Public Service Commission has granted the Cleveland El. Illg. Co. permission to issue $1,500,000 in capital stock and $1,500,000 in bonds, the proceeds to be used for improvements and extensions to its system.

ELYRIA, OHIO.—The Cleveland, Southwestern & Columbus Trac. Co. is in the market for new equipment for its Elyria power house, including boilers, turbines and motors, to cost approximately $100,000.

GREENVILLE, OHIO.—The Public Servic Commission has granted the Greenville El. Lt. & Pwr. Co. permission to issue $25,000 in capital stock, the proceeds to be used for the extension of its transmission lines to supply electricity in the towns of New Madison, West Manchester, Eldorado, Lewisburg and Brookville.

LEBANON, OHIO.—Plans are being considered for increasing the output of the municipal electric-light plant and water-works system.

NEW MADISON, OHIO.—The New Madison Ltg. Co. has been granted permission by the Public Service Commission to issue capital stock for the construction of a distributing system in the town of New Madison. Electricity for operating the system will be supplied by the Greenville El. Lt. & Pwr. Co.

WELLSVILLE, OHIO.—The installation of a municipal electric-light plant here is under consideration.

ELK CITY, OKLA.—The local electric-light plant has been purchased by Dr. Brenham and W. H. Goodhue, of Hobart, who, it is said, will expend $10,000 for improvements and extensions to same.

MULDROW, OKLA.—The city has voted to issue $33,000 in bonds for the construction of water-works and erection of transmission line from Fort Smith, Ark., to Muldrow to furnish electricity to operate the pumping station and for street-lighting. Contract has been awarded to F. R. Stone, of Lima, Ohio. The Western Engineering Co., Oklahoma City, Okla., is consulting engineer.

MUSKOGEE, OKLA.—The Pioneer Tel. & Tel. Co. is planning to provide for about 2500 additional telephones and placing underground about 10,000 ft. of lead cable. Cost of improvements is estimated at about $25,000.

BANDON, ORE.—The electric plant of the Bandon Lt. & Pwr. Co. has been purchased by the Bandon Wtr. Co. Extensive improvements are contemplated. E. E. Johnson is president of the company.

BROWNSVILLE, ORE.—The Oregon Pwr. Co. is planning improvements and extensions to its local system, including the extension of its transmission lines on Walnut Avenue and Main Street.

FREEWATER, ORE.—The Pacific Pwr. & Lt. Co., Portland, Ore., has authorized the erection of 10 miles of transmission lines, costing $9,500, which is a part of the proposed Touchet extension, which, when completed, will be 52 miles long and will supply electricity for 162 miles of territory. E. O. Wedge is local superintendent.

WESTON, ORE.—Arrangements are being made by the Preston-Shaffer Milling Co. to rebuild its electric-light plant in Weston.

PANAMA.—The date of opening for bids for furnishing automatic signal material under circular No. 669 for the relocation of the Panama Railroad has been extended from Jan. 25 to Feb. 8. Major F. C. Boggs is general purchasing officer.

PANAMA.—Bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until Feb. 20 for furnishing lumber and transformers. Blanks and general information pertaining to this circular (No. 678) may be obtained at the above office, or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

PANAMA.—Sealed proposals will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until March 1, for furnishing general control apparatus for lock machinery, including starting panels for all motors which are to be controlled from a remote point, limit switches, commutating switches used in the miter-gate control, auxiliary cut-out switches for miter-gate strut, handrail controllers, miscellaneous remote indicators and indicator controllers, control switchboards for all locks and spillways and control and indicating apparatus for chain fenders. Blanks and general information relating to this circular (No. 679) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is purchasing officer.

CONNEAUTVILLE, PA.—F. C. Eckels, of Conneautville, has been granted a franchise to install an electric-light plant here. Right-of-way has been secured for the erection of a transmission line from Harmonsburg to Conneautville. Arrangements, it is said, have been made with the Northwestern Pennsylvania Ry. Co. for electricity to operate the local system from its plant in Harmonsburg.

HARRISBURG, PA.—Application will soon be made to Governor Tener by Stewart W. Goldsborough, M. B. Young and P. C. McKnight, of Pittsburgh, for charters for the following companies: The West Salem Pwr. Co., the Hempfield Pwr. Co., the Coolspring Pwr. Co., the Jefferson Pwr. Co. and the Delaware Pwr. Co. for the purpose of supplying elec-

tricity for lamps and motors in West Salem, Hempfield, Coolspring, Jefferson and Delaware Townships.

LANCASTER, PA.—Initial steps have been taken to secure electricity to operate the pumping plants in the Antelope Valley. Electricity may be secured from the transmission lines of the Southern Sierra Pwr. Co.

UPPER DARBY, PA.—The Philadelphia & West Chester Trac. Co. is planning to double the output of its Llanerch power plant during the year.

ARMOUR, S. D.—Preparations are being made to supply electricity in Armour, Lake Andes and Wagner from a central power plant located at Wagner.

ELK POINT, S. D.—A franchise has been granted to P. W. Ellis, Ova J. Henkin and Thomas Dwyer to install an electric-light plant here.

GARRETSON, S. D.—The Council is considering the question of establishing a municipal electric-light plant, the cost of which is estimated at about $6,000.

CLEVELAND, TENN.—The Chattanooga & Cleveland Trac. Co. is being organized for the purpose of building an electric railway to connect Chattanooga and Cleveland, a distance of 29 miles. F. W. Adams, of Chattanooga, is interested.

HENDERSON, TENN.—The Priestley-Lord Lt. & Pwr. Co. has awarded a contract to Fairbanks, Morse & Co., Louisville, Ky., for furnishing complete electrical equipment for its power plant, consisting of an 80-hp oil engine, one 55-kw direct-current generator and switchboard, etc.

HUMBOLDT, TENN.—The Gibson County Tel. Co. has increased its capital stock from $5,000 to $10,000, the proceeds to be used for installing a telephone exchange in Humboldt.

LEXINGTON, TENN.—Bids will be received by the Mayor and Board of Aldermen until Feb. 8 for a system of water-works, electric-light plant and sewerage system as follows: For 5.3 miles of 4-in, 6-in., 8-in. and 10-in. water mains with necessary hydrants, valves, steel tower and tank, reservoir, power station, including boilers and auxiliaries, domestic pump and fire pump of 750,000-gal. capacity; electric-light system, consisting of one 100-kva generator, engine type, one 50-kva generator, engine type, two high-speed automatic engines to drive same; street-lighting system, consisting of 12 arc lamps and 75 to 100 tungsten lamps of 100 cp, pole-line construction, including 110,000 ft. No. 6 wire, transformers, pole-line materials of all kinds; sewerage system, consisting of about 2 miles of 8-in., 10-in., 12-in. and 15-in. pipe, 15 manholes, 7 flush tanks and 1 septic tank. Bids will be considered as a whole and also from manufacturers direct. Plans and specifications may be seen at the office of R. C. Huston, consulting engineer, Exchange Building, Memphis, Tenn., or at the office of the city recorder.

MEMPHIS, TENN.—Plans have been completed for the installation of cluster lamps on Madison Avenue. Under the proposed plan the cost of installing the lamp standards is to be paid by the property owners and the expense of maintaining the lamps will be paid by the city. It is proposed to install 80 lamps. The cost of electricity for the lamps will be $54 each per year.

BEAUMONT, TEX.—Plans have been prepared by the Beaumont Lt. & Pwr. Co. for the installation of an ornamental street-lighting system on Pearl Street. The company agrees to install the system provided the property owners enter into a contract with the company for a period of five years to maintain the lamps. The company agrees to furnish the arc lamps at $60 each per year, which is $12 less than the rate the city pays under the present contract.

SAN ANTONIO, TEX.—The capital stock of the San Antonio Gas & El. Co. has been increased from $984,100 to $1,160,000. The San Antonio Trac. Co. has increased its capital stock from $1,000,000 to $1,210,000.

WINTERS, TEX.—The capital stock of the Independent Tel. Co. will be increased from $15,000 to $50,000.

SALT LAKE CITY, UTAH.—The Salt Lake & Oregon Ry. Co. is planning to double-track its railway from Salt Lake City to Ogden.

SALT LAKE CITY, UTAH.—The contract for electric wiring, electrical apparatus and fixtures for the Walker Bank Building has been awarded to the Salt Lake Electric Supply Co., at about $23,000.

CAPE CHARLES, VA.—A bill has been introduced in the Legislature authorizing the town of Cape Charles to issue bonds for the purpose of establishing a municipal electric-light plant.

BELLINGHAM, WASH.—A site has been purchased by Smith, Kerry & Chace, engineers, Toronto, Ont., Can., in Bellingham, on which, it is understood, an electric power plant will be erected.

LYNDEN, WASH.—Smith, Kerry & Chace, engineers, Toronto, Ont., Can., have applied to the Council for a franchise to supply electricity here.

MORTON, WASH.—The Highland Valley Tel. Co. has been granted permission to erect a telephone line from Morton to Riffe. H. E. Teller, James Compton and W. Short are directors.

STEVENSON, WASH.—The Northwestern El. Co. has been granted a franchise to erect transmission lines in this city.

WENATCHEE, WASH.—Announcement has been made of the sale of $1,000,000 in bonds of the Wenatchee Valley Ry. & Pwr. Co., which assures the construction of an interurban electric railway from Malaga through Wenatchee to Leavenworth, a distance of 60 miles.

KIMBALL, W. VA.—The contract for the machinery and electrical equipment for the electric plant of the Kimball Lt., Pwr. & Wtr. Co. has been awarded by the J. G. Russell Co., of Dayton, Ohio, to the Miller Supply Co., of Huntington, W. Va.

SHERIDAN, WYO.—The Sheridan Ry. & Lt. Co. is planning the construction of an extension from Monarch to Ranchester and Dayton, a distance of 10 miles.

CALGARY, ALTA., CAN.—Extensions are contemplated to the municipal electric-light plant, involving an expenditure of $368,000.

EDMONTON, ALTA., CAN.—Improvements will be made to the municipal electric-light plant, to cost about $210,000. Bids will be received for construction about March 1. J. C. Huffman is superintendent.

FERNIE, B. C., CAN.—W. A. Beebe and associates have petitioned the government for permission to construct an electric railway from Cowley to Crow's Nest, a distance of 25 miles.

VANCOUVER, B. C., CAN.—The British Columbia Electric Co. contemplates building about 40 miles of new track this year. The property owners on Nanaimo Street have agreed to give a bonus of $55,000 to extend its railway on Nanaimo Street.

MONTREAL, QUE., CAN.—The Montreal Lt., Ht. & Pwr. Co. has closed a deal for the purchase of the holdings of the Cedar Rapids Pwr. Co. from D. Lorne McGibbon and associates. It is estimated that 150,000 hp can be developed at Cedar Rapids.

New Industrial Companies.

THE BROOK ELECTRIC CONSTRUCTION COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $10,000 to manufacture and deal in supplies and apparatus incidental to the electrical business. The incorporators are: John L. Schreiner, John Wilson, W. J. Hart, H. W. Canfield and H. H. Canfield.

THE CLEVELAND COPEMAN ELECTRIC STOVE COMPANY, of Cleveland, Ohio, has filed articles of incorporation with a capital stock of $10,000. The incorporators are: J. B. Roof, Kent B. North, J. C. Rahming, Julius Bloomberg and E. E. Wolf.

THE DOWN TROLLEY SUPPLY COMPANY, of Toledo, Ohio, has been incorporated with a capital stock of $20,000 by Z. T. Paulin and others.

THE FRANK S. LEASURE & SON COMPANY, of Chicago, Ill., has been granted a charter to do electrical construction work. The company is capitalized at $2,500 and the incorporators are: Frank S. Leasure, Harry E. Leasure and E. M. Leasure.

New Incorporations.

MOBILE, ALA.—The Southern El. Co. has been incorporated with a capital stock of $3,000 by J. A. Hollifield, D. A. Alexander and A. J. Spencer.

LONGMONT, COL.—The Longmont Service Co. has been organized with a capital stock of $50,000 by John Andrew, Asa D. Holt, M. A. Rowen, Frank Wadsworth and W. I. McCashu. The company proposes to supply electricity in Boulder, Larimer and Webb Counties.

ANDERSON, IND.—The Trac., Lt. & Pwr. Co. has been incorporated with a capital stock of $10,000 to generate and distribute electricity to the different towns and cities through which the railway of the Indiana Union Trac. Co. runs. Calvin H. Allen, William H. Forse, Jr., James A. Van Osdal, H. A. Nicholl and Arthur W. Brady are the directors.

SAVANNA, ILL.—The Savanna Mutual Tel. Co. has been incorporated with a capital stock of $15,000 by L. H. Maloney, J. D. Lunness and C. C. Thill.

Trade Publications.

COPPER HISTORY—With the title "Copper History," the Rome Wire Company, Rome, N. Y., has issued a circular giving the monthly average price of copper from 1883 to 1912.

ELECTRIC FANS.—The 1912 catalog of Peerless fans has just been issued by the Peerless Electric Company, Warren, Ohio. The line includes standard types of direct and alternating-current desk, oscillating and ceiling fans, improved in some minor details, but withal the same as heretofore, for fan-motor design has been so standardized and the machine itself made so efficient and dependable that it would be difficult indeed to improve it to any great extent.

ELECTRIC FANS.—The Colonial Fan & Motor Company, Warren, Ohio, has issued its fan catalog for 1912. The company builds alternating and direct-current oscillating, desk and ceiling fans for standard voltages and frequencies, all of which are illustrated and described. Such modifications and improvements as experience has dictated to be necessary are pointed out, although, having long since passed through the experimental stages, the general design remains much the same.

Business Notes.

THE PELOUZE ELECTRIC HEATER COMPANY, of Chicago, Ill., has changed its name to the Pelouze Manufacturing Company, which company will represent a consolidation of the Pelouze Scale & Manufacturing Company with the Pelouze Electric Heater Company.

GARWOOD PHILADELPHIA OFFICE.—The office of the Garwood Electric Company in Philadelphia, Pa., has been removed from the West End Trust Building to No. 613 Betz Building. The company states that the welding business obtained through its Philadelphia office during January has been better than for any previous month.

JOHNS-MANVILLE PITTSBURGH BRANCH.—Due to the increase of its business in Pittsburgh and vicinity, the H. W. Johns-Manville Company found it necessary to seek larger quarters, and on Jan. 24 moved from Liberty Avenue to the northeast corner of Wood Street and First Avenue, where it has leased an entire eight-story concrete and steel building for a term of years.

CONNECTICUT TELEPHONE & ELECTRIC NEW YORK OFFICE.—The Connecticut Telephone & Electric Company, Meriden, Conn., has opened an office, stock and showroom at 231 West Fifty-fourth Street, New York City. A well-assorted stock of Connecticut ignition devices will be carried, and also Connecticut shock abosrbers and fittings made by the Connecticut Shock Absorber Company.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY has commenced business at 436-438 West Broadway, New York City, as a wholesale and retail dealer in electrical supplies. The firm consists of Mr. Leon Portnow and Mr. Charles C. Robinowitch. Mr. Portnow was for four years connected with the Independent Electrical Supply Company, of New York, and Mr. Robinowitch for the same length of time with the E. H. Freeman Electric Company, of Trenton. N. J.

SALE OF ICE-MAKING PLANTS.—Since Nov. 28 the York Manufacturing Company, York, Pa., has sold a total of eighteen ice-making plants, aggregating a capacity of 653 tons of ice daily, and a total of fifty-eight refrigerating plants, aggregating a capacity of 1219 tons of refrigeration daily. In addition to the above it has sold a large quantity of direct expansion piping, ammonia condensers of the double pipe and atmospheric types, freezing and distilling systems, supplies and fittings.

TRIUMPH ELECTRIC COMPANY.—Owing to the increase in its Eastern business, the Triumph Electric Company found it necessary to add two men to its New York sales force, and has recently engaged Mr. S. Morganstern and Mr. Harry D. Garretson. Mr. Garretson has been connected with several of the large electric companies as designer and electrical engineer, and will devote his entire time to the introduction of Triumph transformers and alternating-current equipment for central stations.

TUNGSTEN AUTOMOBILE LAMPS.—The Jaeger Miniature Lamp Manufacturing Company, New York City, has brought out a ¾-amp, 4-cp upset coil lamp for automobile use having a drawn-wire ductile tungsten filament. The filament is turned in a double reversible coil condensed to a point most productive for a concentrated light when the lamp is placed in an upright position in front of a mirror reflector. The lamps are fitted with both Edison and Edi-Swan bases and are also made in higher candle-power ratings.

Directory of Electrical Associations, Societies, Etc.

ALABAMA LIGHT & TRACTION ASSOCIATION. Secretary-Treasurer, Geo. S. Emery, 11 N. Royal St., Mobile, Ala.

AMERICAN ELECTRIC RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary, H. E. Weeks, Davenport, Ia.

AMERICAN ELECTRIC RAILWAY ENGINEERING ASSOCIATION. Secretary, Norman Litchfield, Interborough Rapid Transit Company, New York.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, H. C. Donecker, Engineering Societies Building, 29 West 39th St., New York.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. J. Willard Travell, 27 East 11th St., New York.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS. Secretary-Treasurer, Eugene W. Stern, 103 Park Ave., New York City. The Council meets the first Friday of every month.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson. Engineering Societies Building, 29 West 39th St., New York. Meeting, second Friday of each month, excepting June, July, August and September. Annual meeting, Boston, Mass., June 25-28.

AMERICAN PHYSICAL SOCIETY. Secretary, Ernest Merritt, Cornell University, Ithaca, N. Y.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, E. H. Hardin, Hot Springs, Ark.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, H. T. Edgar, Seattle, Wash.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, James Farrington, Steubenville, Ohio.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary, J. Andreucetti, Chicago & Northwestern Railway, Chicago.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, 135 Adams St., Chicago.

COLORADO ELECTRIC CLUB. Secretary, C. F. Oehlmann. Meets every Thursday at Albany Hotel, Denver, Col.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, F. D. Morris, 323 Hagerman Building, Colorado Springs, Col

ELECTRIC CLUB, CHICAGO. Secretary, W. M. Connelly, 1417 Monadnock Block, Chicago. Meets every Wednesday noon, 303 Wabash Ave.

ELECTRICAL CONTRACTORS ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo.

ELECTRICAL CREDIT ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 125 Michigan Ave., Chicago. Annual meeting, Chicago, January each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

ELECTRIC TRADES ASSOCIATION OF PHILADELPHIA. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursday of each month.

ELECTRICAL VEHICLE ASSOCIATION OF AMERICA. Assistant Secretary, Harvey Robinson, 245 West 42d St., New York. Meetings, fourth Tuesday of each month.

EMPIRE STATE GAS & ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, Engineering Societies Building, 29 West 39th St., New York.

FLORIDA ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, H. C. Adams, West Palm Beach, Fla.

GAS, ELECTRIC & RAILWAY ASSOCIATION OF OKLAHOMA. Secretary H. V. Bozell, Norman, Okla.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, P. S. Millar, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, L. H. Woods, 2355 Jerome Ave., New York.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, J. V. Zartman, Indianapolis, Ind.

INTERNAL COMBUSTION ENGINE ASSOCIATION. Secretary, Chas. Kratch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England. Next meeting at Berlin in 1913.

IOWA ELECTRICAL ASSOCIATION. Secretary, A. W. Zahm, Mason City, Ia.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, H. E. Weeks, Davenport, Ia.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan.

LOUISIANA ELECTRICAL ASSOCIATION. Secretary, W. H. Bower Spangenberg, 627 Poydras St., New Orleans, La. Meets third Monday of each month.

MAINE ELECTRICAL ASSOCIATION. Secretary, Walter S. Hyman, Waterville, Maine.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, Herbert Silvester, 18 Washington Boulevard, Detroit, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, E. T. Street, 76 West Third St., St. Paul, Minn. Next annual meeting, March 20-22, 1912, Minneapolis, Minn.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER ASSOCIATION. Secretary, N. J. Cunningham, Springfield Gas & Electric Co., Springfield, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next annual convention at Detroit, Mich., June 25-27, 1912.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica. N. Y. Next annual convention, July 17-19, 1912, Denver, Col.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive Secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York. Next annual convention at Seattle, Wash., June 9-15, 1912.

NATIONAL ELECTRIC LIGHT ASSOCIATION, CANADIAN SECTION. Secretary, T. S. Young, 220 King St. West, Toronto, Can.

NATIONAL ELECTRIC LIGHT ASSOCIATION, GEORGIA SECTION. Secretary-Treasurer, T. W. Peters, Columbus Railway Company, Columbus, Ga.

National Electric Light Association, Mississippi Section. Secretary, A. H. Jones, McComb City, Miss.

National Electric Light Association, Nebraska Section. Secretary-Treasurer, S. J. Bell, David City, Neb.

National Electric Light Association, New England Section. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass. Next annual convention, Springfield, Mass., March 21 and 22, 1912.

National Electric Light Association, Pennsylvania Section. Secretary-Treasurer, W. E. Long, Philadelphia, Pa.

National Electric Inspectors' Association. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

National Electrical Credit Association. Secretary, Frederic P. Vose, 1343 Marquette Bldg., Chicago.

National Fire Protection Association. Secretary, R. Sweetland, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1913.

National Independent Telephone Association. Secretary, Joseph B. Ware, Grand Rapids, Mich. Next annual convention, Feb. 7-9, 1912, Chicago, Ill.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New Orleans Electrical Contractors' Association. Secretary, L. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesday of each month.

New York Electrical Society. Secretary, G. H. Guy, Engineering Societies Building, 33 West 39th St., New York.

Northwest Electric Light & Power Association. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next annual meeting, Breakers Hotel, Cedar Point, Ohio, July 16-19, 1912.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, Prof. I. E. Sanborn, Ohio State University, Columbus, Ohio.

Pittsburgh Electric Booster Club. Recording Wattmeter, O. R. Bombach, 919 Liberty Ave., Pittsburgh, Pa. Meetings, fourth Monday of each month.

Rejuvenated Sons of Jove. Jupiter, R. L. Jaynes, Pittsburgh, Pa.; Mercury (Secretary), E. C. Bennett, St. Louis, Mo.

Society for the Promotion of Engineering Education. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.

Society of Wireless Telegraph Engineers. Secretary, E. B. Moore, 39 Trinity Place, Boston, Mass. Monthly meeting, first Saturday of each month, at the Massachusetts Institute of Technology, Boston.

Southwestern Electrical & Gas Association. Secretary, D. G. Fisher, 1316 Commerce St., Dallas, Tex.

Street Railway Association of the State of New York. Secretary, J. C. Collins, Rochester, N. Y.

Vermont Electrical Association. Secretary-Treasurer, A. B. Marsden, Manchester, Vt.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 76 West Monroe St., Chicago, Ill.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, Tuesday after Jan. 1 each year.

Wireless Institute. Secretary, Alfred N. Goldsmith, College of the City of New York, New York.

Wisconsin Electrical Association. Secretary, George Allison, Stephenson Building, Milwaukee, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JAN. 23, 1912.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,015,300. AUTOMATIC LOCK SWITCH; W. R. Cox, Cleveland, Ohio. App. filed Aug. 4, 1910. Pin-tumbler cylinder lock for automobile ignition system switch.

1,015,306. GAS-LIGHTING BURNER; E. N. and E. A. Frary, South Deerfield, Mass. App. filed Nov. 5, 1910. Electromagnetically operated break-spark terminals.

1,015,317. DRY CELL; F. J. Humel, Cleveland, Ohio. App. filed Oct. 14, 1911. Has a perforated tubular carbon electrode surmounted by a dry mix.

1,015,414. TELEPHONE REPEATING SYSTEM; C. Adams-Randal, New York, N. Y. App. filed Dec. 20, 1910. The controller is in an independent circuit and is manually governed.

1,015,439. SMELTING FURNACE WITH ELECTRIC REFINING HEARTHS CONNECTED THERETO; A. Helfenstein, Vienna, Austria. App. filed March 8, 1911. For iron and steel.

1,015,442. CIRCUIT INTERRUPTER; C. J. Hixson, East Orange, N. J. App. filed Feb. 23, 1907. A magnetic electrode and a yieldingly supported electrode.

1,015,534. ALTERNATING-CURRENT MOTOR; A. C. Bell, Westfield, N. J. App. filed March 28, 1910. Centrifugal short-circuiting device acting when the motor attains full speed.

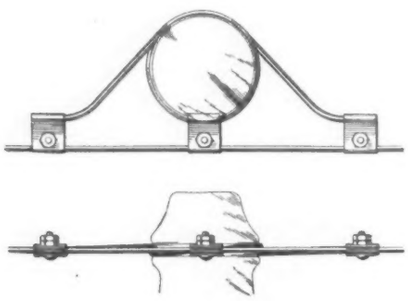
1,015,546. ELECTROLYTIC CELL; W. H. Davis, Boulder, Col. App. filed Dec. 14, 1910. Precipitation of the metallic constituents of solutions obtained in the cyanide or chlorination treatment of gold ores; rotary-screen electrode in the flow of liquid.

1,015,613. ELECTRIC SWITCH; G. A. Burnham, Saugus, Mass. App. filed June 17, 1911. Main and auxiliary oil switches.

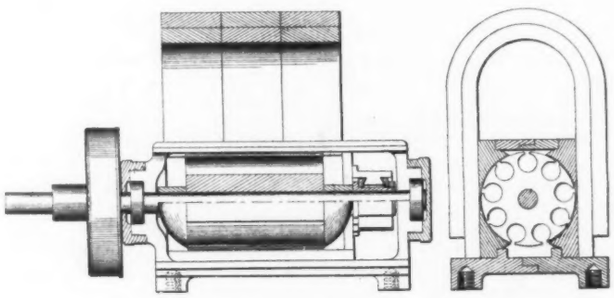
1,015,623. MAGNETO; S. L. Kelly, South Bend, Ind. App. filed May 5, 1910. A casing formed in two parts and watertight; held together by threaded end caps.

1,015,644. SELECTOR FOR AUTOMATIC TELEPHONE EXCHANGES; B. Settegast, Karlshorst, Berlin, Germany. App. filed May 23, 1910. Detail improvements on the Strowger type, the parts being mainly of sheet-metal stampings. Forty-four claims.

1,015,720. PROCESS OF AND APPARATUS FOR MAKING CALCIUM CYANAMIDE FROM CALCIUM CARBIDE; F. S. Washburn, Nashville, Tenn. App. filed July 29, 1911. Thin superposed layers of carbide are heated in nitrogen.



1,015,513.—Wire Tie.



1,015,623.—Magneto.

1,015,484. ELECTRIC-CONDUCTOR DISTRIBUTOR; F. W. Erickson, New York, N. Y. App. filed June 24, 1911. A supporting trough with attaching clips.

1,015,492. ELECTRIC WELDING MACHINE; J. A. Heany, Flint, Mich. App. filed Jan. 11, 1911. Mechanical details to adapt the mechanism for handling miscellaneous work.

1,015,494. ELECTRIC TRANSMISSION OF INTELLIGENCE; I. Kitsee, Philadelphia, Pa. App. filed July 3, 1911. Magnetic coils for neutralizing the inductive effect of one circuit upon another.

1,015,513. WIRE TIE; J. J. Sanders, East Grand Forks, Minn. App. filed July 6, 1911. A loop with clips for fastening a live wire to an insulator.

1,015,523 MAIL-BOX SIGNAL; W. M. Ulbrich, Atlantic, Ia. App. filed June 22, 1910. For rural free-delivery route boxes to signal in the house.

1,015,728. LIFTING MAGNET; A. C. Eastwood, Cleveland, Ohio. App. filed May 13, 1910. Excluding moisture and permitting expansion of the insulation.

1,015,734. PRIMARY BATTERY; R. V. Heuser, Waterbury, Conn. App. filed Sept. 10, 1910. Le Lalande type with copper oxide, metallic sodium and a caustic-soda solution.

1,015,735. PRIMARY BATTERY; R. V. Heuser, Waterbury, Conn. App. filed April 25, 1911. Sodium amalgam positive electrode.

1,015,748. ELECTRIC CLOCK; A. Tuerk, Chicago, Ill. App. filed Aug. 9, 1909. Structural improvements on Patent No. 698,158.

13,365. (Reissue). METHOD OF AND MECHANISM FOR PRODUCING MUSICAL SOUNDS; G. Breed, Philadelphia, Pa. App. filed Dec. 5, 1911. Electromagnetically vibrated strings. Original Patent No. 1,007,265.